SCIENCE

VOL. 85 FRIDAY, MARCH 12, 1937 No. 2202

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

TIMBERLINES AS INDICATORS OF CLIMATIC TRENDS[1]

By Dr. ROBERT F. GRIGGS
THE GEORGE WASHINGTON UNIVERSITY

EVEN though Hutton and Lyell more than a century ago established the principle that the face of the earth has been shaped by forces still in operation, there has remained a great gulf between the geological past and the historical past. Almost ironically, the geologists denominated as "recent" formations of an antiquity far beyond the reach of history. The attempt to bridge the gulf and to connect the past with the present, actually as Lyell did theoretically, is a recent development. The progress toward the construction of a continuous chronology back into the geological past is one of the most significant scientific developments of the last decade. The problem has been attacked from a number of different angles: The excavations of archeologists and their correlation with geological terrains, the records of the annual varves in water-laid deposits collected by DeGeer and in America by Antevs[2]; the interpretation of variant thickness of tree rings in ancient logs by Douglass[2]; the identification of subfossil pollens under the leadership of Erdtmann[3]—each in its own way has helped to carry the chronicle back.

But with all that may be learned by these and other methods, our knowledge of the past must remain very fragmentary. And, what is far more important from my point of view, our appreciation of the long-time climatic trends, which in the end must mould our civilization, is as yet hardly dawning.

[1] Address to the Geological Society of Washington, October 28, 1936.

[2] For a general account see Smithsonian Inst. Publ. No. 3152, pp. 304–312, 1931.

[3] G. Erdtmann, *Archiv. f. Bot.*, 77: 1–173, 1922.

Only recently have we become aware of the fact that in some countries there have been vast changes in climate within the period of civilization, or even within the last thousand years. On the contrary, mankind has generally assumed that such climatic changes as obviously must have occurred in periods of glaciation came on too slowly to have any human importance. More recently, however, our eyes have been opened to the significance of many signs of great climatic changes within historic times. To illustrate my point I need only to cite the extensive evidences of civilization left by former agricultural peoples in parts of Syria now quite too arid for agriculture,[4] or the Old Norse colonies in Greenland whose prosperity was sustained by dairy farming for several hundred years in a region where to-day it is impossible to grow winter feed for cattle. The colonists were buried in ground now perpetually frozen, but their coffins and even the marrow of their bones were permeated by masses of tree roots, which is indubitable evidence of mild temperatures at that time, for roots can not grow into frozen soil.[5]

One of the most significant contributions of geology to biological theory is the revelation of vast migrations of plants and animals over the face of the earth in past times. Knowledge of the movements of the past should surely lead us to suppose that similar migrations are in progress to-day with as great activity as they ever were in past ages. But it is one of the curiosities of scientific thinking that neither botanists nor zoologists have made any serious effort to detect such movements in progress. Indeed, the science of ecology has been built on the contrary assumption that organisms are in stable equilibrium with their environment, which is the same as saying that species have spread as far as is permitted by physical barriers. It ought to be no very difficult matter to put this assumption to the test and to ascertain in the case of any given plant whether its range is fixed or changing; whether it is just holding its own, advancing into new ground, or giving way before adverse factors which are pressing it toward extinction. Once we obtain a considerable body of data we should be able to form reliable judgments of the climatic trends that are factors in any movements brought to light.

The place to study plants or animals in migration is at the limits of their ranges. Just as it is difficult to observe the ebb and flow of the tides in mid-ocean, so it is difficult to discover biotic shifts in the middle of specific areas. But exactly as one can readily observe small changes in tide level on a sloping beach, so can one detect very slow advances or retreats of species at the edges of their ranges where they stop short and drop out.

My interest was first drawn to the problem when I was working in the Sugar Grove region in Ohio more than twenty-five years ago.[6] But my real opportunity to pursue the matter came with the Katmai expeditions of the National Geographic Society, which took me to the arctic timberline in Alaska.

The town of Kodiak stands almost exactly at the edge of the great forest of Sitka spruce which stretches up the Pacific coast from Oregon and Washington. On the mainland the interior forest of Canadian white spruce likewise reaches its terminus within a few miles of the Valley of Ten Thousand Smokes.

These timberlines naturally invited research into the factors which fixed their position. I say fixed their position, for at the beginning I had no idea other than that they must have extended as far as the climate would permit. So I began the study with the belief that further spread of the trees must be prevented by a failure somewhere of their mechanism for dissemination. Was the climate too severe for them to grow a crop of cones? Did such cones as might occur bear viable seed? Was there heavy mortality among seedlings? Were the trees so stunted that their growth could not keep ahead of death from adverse factors? How did their rate of growth compare with that of the same species several hundred miles back from the edge of the forest?

In none of these particulars were the spruces at Kodiak deficient. They bore cones profusely in each of the six seasons that we observed them. The volcanic ash was in places covered with seedlings as thick as they could stand—a growth much denser than could possibly survive. Other seedlings better spaced continued to thrive and grow vigorously. Neither the form of the trees nor their annual increment suggested stunting. There was none of the dead wood characteristic of timberlines generally. The average width of the growth rings measured at Kodiak was close to one tenth of an inch. Occasionally a tree increased more than an inch in a single year. The growth in thickness is not less but actually somewhat greater than in the same species, as measured by the Forest Service in southeastern Alaska.

Nothing that could be observed about the trees at Kodiak, therefore, gave any indication that they had reached their limit and were held in check by climatic factors. On the contrary, it was found that while all the trees at the very edge of the forest were small they were also young, seldom more than half a century old. Again, there are no dead trees nor fallen logs at the edge of the forest. But three miles back within

[4] Ellsworth Huntington and Stephen S. Visher, "Climatic Changes, Their Nature and Causes." New Haven, Yale University Press, 1922.

[5] W. Hovgaard, *Geog. Rev.*, 15: 605–615, 1925.

[6] R. F. Griggs, *Bull. Torr. Bot. Club*, 41: 25–41, 1914; *Ecology*, 15: 80–96, 1934; *Ecology*, 17: 580–417, 1936.

the forest were many trees three hundred years old or more, while fallen logs abounded, as in normal forests. Everything that could be observed on the ground, therefore, suggested that instead of being held to a stationary line the forest was advancing.

The conclusion that the forest is advancing in Alaska is by no means original with me. The conditions have been noted by many of the observers who have described the region beginning with Petrof in 1884.[7] The explorers sent out by the Alaska division of the Geological Survey report substantially similar conditions throughout western and northern Alaska.[8] The most easterly point at which an advancing timberline has been definitely reported is at Wiseman (Long. 150°, Lat. 67°30′) by Robert Marshall. Historical accounts of the country in early days confirm conclusions drawn from the forest itself. A century ago the people of Kodiak had to go many miles to find wood such as now grows nearby. There are two islands near Kodiak which in the coast pilot of 1875 are called Woody Island and Bare Island. Woody Island still retains its name, but Bare Island is now covered with heavy forest, and its name has been replaced by another more appropriate. There can be no doubt, therefore, that the forest is actively migrating out into the tundra at Kodiak. One further question for a long time undermined confidence in the conclusions reached. Evidence drawn from the trees on the ground can at best go back only a few hundred years. We might be dealing with nothing more than an episodic oscillation of timberline swinging about a mean which after a few centuries of advance would retreat again, leaving things as they were. To assure ourselves in this matter my colleague, Dr. Paul W. Bowman, made a study of the fossil pollens from the bogs at Kodiak.[9] There was no spruce pollen except an occasional grain such as would be blown from a great distance. The present forest is therefore the first that has occupied this country since the beginning of the bogs.

Turning now to climatic correlations, we find a general belief among botanists, not very well supported by evidence, to be sure, but conforming fairly well with many facts, that tree growth is limited by the isotherm of 10° C. (50° F.) for the warmest month. It is interesting to observe that in southwestern Alaska the isotherm stands 250 miles beyond the edge of the forest.

The facts indicate, I think, that there is occurring in Alaska a plant migration of exactly the same character as the paleontologist finds evidence of in past geological ages. Apparently the climate of Alaska has become mild so recently that the trees have not been able to keep up with the change and occupy all the territory suitable for them.

It should be noted that no certain indication is given as to whether the improvement has stopped or is still going on. But the presumption would be that before dying out the change would slow down, giving the trees opportunity to catch up. Study of this migration front at Kodiak yields information which is probably valuable in reaching an understanding of other migrations past and present. It gives a clue, perhaps, to the failure of botanists generally to recognize migrations in progress. We all know that the winged seed of a spruce tree may be carried many miles by the wind, so that the country beyond the forest border must be liberally sown with tree seed every year. It might be expected therefore that the forest would spread with great rapidity, in the same way that pioneer plants come in on ground laid bare by the retreat of a glacier or as foreign weeds spread like wildfire through cultivated ground.

But the advance of one plant association against another is quite different from the invasion of bare ground where the newcomers meet no competition. The country beyond the forest in Alaska is thickly covered with other vegetation, tall grass or vigorous health which chokes intruders. Very few of them succeed in establishing themselves. The abundant seedlings observed at Kodiak were coming up on the new surface provided by the ash from Katmai. Instead of advancing many miles per annum, therefore, the forest creeps into the grassland very slowly. At Kodiak the advance is of the order of one mile per century.

This will seem a very slow migration, yet to a person on the ground the progress of the trees appears rapid—so conspicuous that it has been noticed and commented on by many non-botanical observers. The advance in northwestern Alaska reported by the geologists is much slower, probably not one tenth as fast. This may seem excessively slow, but I suspect that as such migrations go it is rapid. I have no doubt but that with proper technique advances or retreats of vegetation lines as slow as a mile in a hundred thousand years would be readily observable. But it would probably not be possible to assign quantitative rates to slow migrations.

If the testimony of the varves is to be relied on as evidence of the rate of climatic change responsible for the glacial retreat, movements of species on the edges of their ranges slower than changes in Pleistocene climate can be detected. There is little doubt that a comprehensive study of the many species which reach their limits in the vicinity of Washington, for instance, would give us a good picture of current trends in plant

[7] Ivan Petrof, Alaska, U. S. Tenth Census, Pt. 8, p. 75, 1884.

[8] Philip S. Smith and J. B. Mertie, U. S. Geol. Survey Bull. 815, p. 72, 1930.

[9] Paul W. Bowman, *Ecology*, 15: 97–100, 1934.

migration and probably of climatic change also, in this vicinity.

Returning now to the more immediate problem revealed by conditions in Alaska, we must inquire as to the extent of the migration and climatic change indicated. In our southwestern States the flora gives much evidence of having been in a static condition over a long period. There is no time here to go into the details of this evidence. I will merely cite Pearson's[10] careful study on the San Francisco Mountains of Arizona, where his instruments at timberline gave exactly the theoretical temperature limit, showing during the years of observation an isotherm of precisely 50° for July.

In northeastern America, on the other hand, the starvation of the Norse colonies in Greenland, already alluded to, indicates deterioration of climate perhaps compensating the amelioration demonstrated in Alaska. This suggestion is supported by the opinion of Canadian explorers, who think that the forest is retreating in that quarter. But the forest border has never been carefully studied there, and conditions certainly should be looked into.

Meanwhile, the more immediate question seemed to be to find out how far east and south the forest advance might extend. Accordingly, I spent the field season of 1935 studying timberlines in the mountains lying between the apparently static condition of the Southwest and the unstable forest border of Alaska, working north from southern Wyoming to Jasper and back again in the Cascades.

There are in this region many places where young trees are advancing into grassland areas, giving appearances very similar to the migrating forest front at Kodiak. Such a place, which is well known to many of you, is Paradise Park on Mount Rainier. But almost without exception when such places were studied there was clear evidence of an earlier forest in the shape of old stumps or charcoal. Though no evidence of fire was detected in Paradise Park, charred logs abound not many miles away in Indian Henry's Hunting Ground, where new growth is also coming in, as in Paradise Park. Thus it seems likely that all the manifest upward extension of the forest about Mount Rainier is merely in the nature of recovery from fire rather than real advance. Such parks, moreover, lie below the limit of trees. Higher up on Mt. Rainier as elsewhere the last trees are prostrate mats which give evidence of having ascended as high as climate will permit.

A climatic timberline, representing as it does a delicate balance between opposing forces in nature, is modified by very slight disturbances and recovers its original condition very slowly. When a Douglas fir or yellow pine forest in the Rocky Mountains burns it is replaced by lodgepole pine, and no man knows how many centuries elapse before the original climax forest returns—this at low altitudes. At timberline recovery is much slower. But though on Mount Rainier the original timberline forest was in places, at least, destroyed by fire, fires are in general less frequent near the peaks than at the foot of the mountains.

A more common source of timberline modification is grazing. It is astonishing to one who has not studied the matter to find how little grazing it takes to disturb conditions at timberline. Around Lake O'Hara in the Canadian Rockies, for example, sheep or cattle have never been grazed, as they have on almost all the mountain meadows in our national forests. The only live stock which has been pastured there is a small number of pack horses used by tourists going in and out to the lake. But one familiar with primeval timberlines at once recognizes that the foraging of these animals has upset natural conditions. Wherever undisturbed timberlines were found in the Rocky Mountains, they appeared to be stabilized. No evidence of advance was detected.

In a few places, as around Lake Louise and on Mount Hood, there was, locally, clear evidence that timberline was in retreat. Such isolated withdrawals are presumably due to locally unfavorable conditions. Dr. W. W. Rubey informs me, for example, that the white-bark pines in the southern part of the Wyoming Range have recently died in large numbers. Local irregularities of this sort are to be expected. They serve to emphasize the necessity of an extensive view if conclusions as to climatic change are to be drawn.

The stability of timberlines in the Rocky Mountains, coupled with rapid advance in western Alaska and evidence of increasing cold in northeastern Canada, affords, I think, an important insight into the character of climatic changes in general. In common with most others, I used to suppose that the great climatic changes indicated in geologic times were world-wide in scope. Conditions here in North America make it clear that shifts in climate of sufficient magnitude to become of geological significance are not necessarily even continental in extent, but may occur in much smaller areas. It will be recognized that this greatly simplifies the problem of accounting for such things as ice "ages," since it may involve merely a redistribution of the heat and rain received by the earth rather than variations in the total amount. It is clear, for example, that an interchange of the climate now prevailing in southern Norway with that of Greenland at the same latitude would have a profound effect on the floras of those regions and would, indeed, make the

[10] G. A. Pearson, U. S. Dept. Agric. Tech. Bull. 247, 1931.

name Greenland again appropriate, as it was when the country was originally discovered, permitting again its enthusiastic colonization by people familiar with Norway.

Like the archeologists who unearthed the evidence that the climate in Greenland had changed so radically, the botanist is unable to bring forth the data from meteorology, geology and oceanography which might enable us to understand the change demonstrated. But if we are convinced that we are witnessing just such a climatic change as has characterized the Pleistocene throughout, researchers in these sciences ought to be able to discover the causes at work and thus to find the answer to what is perhaps the greatest riddle of geology.

Meanwhile, there is an immense amount of work to be done in examining plants on the edges of their ranges everywhere. This I expect to push actively myself, and it is my earnest hope that others also may be persuaded to take up the work and push it along until a mass of data and a technique adequate for broad general conclusions may become available.

OBITUARY

RICHARD CRITTENDEN McGREGOR

THE death at Manila, on December 30, 1936, in his sixty-sixth year, of Richard Crittenden McGregor, chief of the division of publications, Department of Agriculture and Commerce, and managing editor of the *Philippine Journal of Science,* brought to a close the career of one of the rapidly dwindling number of early American pioneers in scientific work in the Philippines. Born in Sydney, Australia, on February 24, 1871, he was educated in Stanford University, where he obtained his A.B. in 1898. After five years of varied field experiences in Panama, in Lower California and in the U. S. S. *Pathfinder,* he came to the Philippines in 1901 to join the staff, as ornithologist, of the Bureau of Science, which at that time was just being organized. The enthusiasm he put into the then almost virgin field of Philippine ornithology is attested by the fact that our present coordinated knowledge on over 750 species, in about 300 genera, a good number of them being unknown to science before he had taken a hand, is largely due to his efforts. McGregor's basic work on the features of distribution of bird genera and species in the Philippines has furnished one of the most convincing lines of evidence in the faunistic alliances of the various islands in the Archipelago.

But it is not in birds alone that science in the Philippines is indebted to him. He was an inveterate collector of natural history objects. Many species of insects and other animals, as well as of plants, have been described or recorded from many parts of the Philippines that are difficult of access, on the basis of material brought back by McGregor from his numerous field trips.

Although formally designated managing editor of the *Philippine Journal of Science* in 1919, his editorial connection with that paper had long antedated that year. He was largely responsible for making it a worthy exponent of scientific progress in this part of the world. McGregor had, prior to his death, been waging a two-year losing battle with polyneuritis, which rendered him almost a cripple. But, so devoted was he to the task that, a few weeks before the end, when he must have been suffering intense physical pain, he wrote the undersigned from his sick bed (August 2, 1936): "I do nothing but work on copy and proof, and even so am never out of work. I don't mind working Sundays, but I miss wandering around the fields and forests."

Posterity is prone to give all the honor to the United States army and navy forces for the successful implantation of American sovereignty in the Philippines. In the rapid pacification of the Philippines and the progress the country attained under American direction along educational and material lines, their due share of the credit is quite frequently denied the early American civilian workers—educators and scientists of the type of Richard Crittenden McGregor. Careless of his own well-being, absorbed as he was in the stronger call of scientific pursuits, but meticulous to a fault, even to the extent of going out of his way, where it involved the welfare of his coworkers, contagious in his zeal for work, patient, thoroughly human—his were the attributes that would attain the effective conquest of any people.

LEOPOLDO B. UICHANCO
COLLEGE OF AGRICULTURE,
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HARRY NELSON VINALL

HARRY NELSON VINALL, senior agronomist of the Bureau of Plant Industry, U. S. Department of Agriculture, died suddenly on February 22 at his home in Washington, D. C., as the result of a heart attack. He had been connected with the department since 1906, devoting his time to research with forage crops, especially sorghums and grasses. During the last ten years he had been particularly active in pasture research. Born on a farm in Story County, Iowa, the son of George W. and Delina Neal Vinall, he was graduated a bachelor of science from Kansas State Agricultural College in 1903 and a master of science from Cornell

University in 1912. He is survived by his widow, Mary Agnes Austin Vinall, whom he married in 1912. Mr. Vinall was a member of the American Association for the Advancement of Science, the American Society of Agronomy, the American Genetic Association, Botanical Society of Washington, Sigma Xi and Phi Kappa Phi. P. V. C.

RECENT DEATHS AND MEMORIALS

DR. WILLIAM T. HORNADAY, who retired as the first director of the New York Zoological Park in 1926 after serving for thirty years and who since has devoted himself to the protection of wild life, died on March 6 at the age of eighty-two years.

DR. WILLIAM ALANSON WHITE, for the last thirty-four years superintendent of St. Elizabeth's Hospital at Washington, D. C., and professor of nervous and mental diseases at the George Washington University, died on March 7. He was in his sixty-eighth year.

DR. J. J. DAVIS, who since 1911 has been curator of the University of Wisconsin Herbarium, died on February 26. He was eighty-four years old.

WILLIAM M. BEAMAN, chief of inspection and editing of the topographic branch of the U. S. Geological Survey since 1918, died on March 1.

C. P. BLACKWELL, dean of the School of Agriculture of the Oklahoma Agricultural and Mechanical College and director of the experiment station at Stillwater, formerly professor of agronomy at Clemson College, S. C., died on March 4, at the age of fifty years.

DR. CHESTER ROY GARVEY, assistant professor of psychology at the Carnegie Institute of Technology, died on January 26 at the age of thirty-four years.

Nature reports the death of Professor Max W. C. Weber, formerly professor of zoology and comparative anatomy in the University of Amsterdam, on February 7, aged eighty-four years, and of Dr. Alfred Daniell, author of "Text-book of the Principles of Physics," on January 12, aged eighty-three years.

THE dedication of the Theobald Smith Memorial Laboratory of Albany Medical College, Union University, will take place on March 19, 1937. In the afternoon Dean Thomas Ordway will make an address at the unveiling of a plaque of Theobald Smith. At the evening exercises Dr. Charles R. Stockard, of Cornell University Medical College, will deliver an address on "The Spirit of the Laboratory." The Theobald Smith Memorial Laboratory houses the departments of physiology and pharmacology and of experimental surgery.

THE South Eastern School of the Society of Foresters will erect a memorial to the late Dr. Austin H. Cary in the forest that has been named in his honor at the University of Florida.

SCIENTIFIC EVENTS

THE WILD LIFE FEDERATION

AT the recent meeting in St. Louis of the North American Wild Life Conference a permanent Wild Life Federation was formed. Delegates to the conference voted unanimously to ratify the constitution which was presented at the meeting in Washington last year. The federation as set up at present represents some 3,000,000 persons. It was stated that it had a potential representation of 36,000 groups, with an estimated membership of 30,000,000 citizens.

Jay N. Darling, of Des Moines, who was chief of the Bureau of Biological Survey from March, 1934, to November, 1935, long a leader in the fight to coordinate conservation forces, was elected president by acclamation. The delegates gave him an ovation when his name was proposed by William Tucker, of Texas.

At the afternoon session Mr. Darling recommended a seven-point program to be pressed by the federation, as follows:

1.—Establishment of government responsibility for restoration and conservation of wild life.

2.—Establishment of standing committees of both houses of Congress to further conservation interests.

3.—Adequate funds for the United States Biological Survey and United States Bureau of Fisheries.

4.—Cooperative research between the Federal and State Governments on matters affecting wild life, with the earmarking of funds taken in taxes from sportsmen for conservation—$3,500,000.

5.—Complete federal custodianship of waters.

6.—Federal appropriations for wild life research.

7.—Support of program for continued enforcement of all game laws.

Several resolutions were adopted covering high points of the conservation program.

The first official action taken by the federation was to approve a plan to carry the conservation message into the homes of the nation through the establishment of an annual "Wild Life Restoration Week," which was set tentatively as the week of February 20, 1938. Before that time the federation will initiate an intensive educational campaign.

The following resolutions were adopted by the federation:

Federal aid should be extended to state wild life projects by earmarking funds now received by the United States Treasury from the 10 per cent. excise tax imposed on the sale of sporting arms and ammunition.

The CCC, United States Forest Service and Park Service should conform to sound policies of wild life management.

Any modification of federal law relaxing restrictions on importations of live stock from countries where foot and mouth disease now exist should be vigorously opposed.

The Federal and State Governments should make adequate appropriations for wild life research.

The open season for trapping should be not more than two months in the prime fur season, issuance of special licenses for trappers only and passage of laws to protect fur bearers.

The following vice-presidents, to assist President Jay N. Darling, were elected: David Aylward, secretary of the Massachusetts Fish and Game Association, Peabody, Mass.; William L. Finley, of Portland, Ore., and Dr. Walter B. Jones, of Tuscaloosa, Ala., director of the Alabama Museum of Natural History and state geologist.

REORGANIZATION OF THE COLLEGE OF PHARMACY OF COLUMBIA UNIVERSITY

A JOINT committee, consisting of five members from the faculty of Columbia University and three members from the College of Pharmacy, has made a survey of the school in order to make suggestions in regard to enforcing higher standards of admission, the introduction of academic subjects into the curriculum and in general a closer relationship between the college and the university.

Representing Columbia University on the reorganization committee were: Arthur W. Thomas, professor of chemistry, *chairman;* Charles C. Lieb, Hosack professor of pharmacology; George B. Pegram, professor of physics; Frank H. Bowles, acting director of university admissions, and Frank D. Fackenthal, secretary of the university. Members of the College of Pharmacy were Edward Plaut, chairman of the board of trustees, *chairman;* Dr. Hugo H. Schaefer, associate professor of chemistry, and Dr. Charles W. Ballard, professor of materia medica. The report of the committee has been approved by the president and council of the university.

A greater interchange of students between the College of Pharmacy and the university is expected to result from the reorganization plan, which will go into effect at the opening of the September term. Many of the courses to be introduced will be identical with those now offered at Columbia College, especially in the field of chemistry.

In commenting on the plans for the reorganization Dr. Ballard said: "This is the first attempt in New York State to develop a close contact between a pharmacy school and its university. We anticipate fewer students the coming year as a result of the higher academic entrance requirements that the university will demand, but we need a higher type of pharmacist."

Another committee, consisting of Dean W. F. Rudd, of the School of Pharmacy, Medical College of Virginia; Dr. W. G. Crockett, president of the American Association of Colleges of Pharmacy, and Dr. Ernest Little, of Rutgers University, has been appointed to make a supplementary survey, to aid in the final reorganization plans.

ECLIPSE EXPEDITION TO THE SOUTH SEAS

PROFESSOR S. A. MITCHELL, director of the Leander McCormick Observatory of the University of Virginia, will be the leader of an expedition sponsored by the National Geographic Society and with the cooperation of the U. S. Navy. The total solar eclipse of June 8 will be observed from one of the islands of the Phoenix Group in the South Pacific Ocean. The other members of the scientific party are: Captain J. F. Hellweg, U. S. N., superintendent of the U. S. Naval Observatory, who will have charge of the Navy's participation in the expedition; Dr. Heber D. Curtis, director of the University of Michigan Observatory; Dr. Paul A. McNally, S.J., director of the Georgetown University Observatory; Professor F. K. Richtmyer, Cornell University; Dr. Theodore Dunham, Mt. Wilson Observatory; Harold E. Sawyer, assistant director of the McMath-Hulbert Observatory; John E. Willis, Naval Observatory, together with a photographer from the National Geographic Society and two radio engineers from the National Broadcasting Company.

The members of the expedition will sail from California by passenger steamers on April 27. With the extensive equipment aboard they will leave Honolulu on May 6 for the trip of 1,800 miles on the U. S. S. *Avocet,* a mine sweeper recently converted to a naval tender. Two of the Phoenix Islands, Enderbury and Canton, are available. The former is nearer the center of the shadow path with a duration of 4 mins. 8 secs., but the landing of the equipment may be difficult. If the landing is too difficult, Canton Island, where the duration is 29 secs. less, may be occupied. The 1937 eclipse has a maximum duration of totality of 17 mins. 4 secs., a longer observation than for any eclipse in 1,200 years. Unfortunately the location where the maximum occurs is 1,500 miles from any land.

The expedition will live in tents ashore. In erecting the instruments the astronomers will have the assistance of the officers and men of the naval vessel, which will stand by during the month of preparation. The equipment will be carried in a hundred cases weighing some ten tons.

The program will be a comprehensive one involving the following: (1) Times of contact observed visually and photographically; (2) photographs of the corona with various cameras and focal lengths up to 19 feet, with ordinary plates, with filters and in color (by three different processes); (3) photographs of the flash

spectrum with concave grating spectrographs used both with fixed and jumping films; (4) photographs of the coronal spectrum with various spectrographs, one using a Schmidt lens; (5) measurement of the total light of the corona; (6) measurement of the percentage of polarized light in the corona; (7) shadow bands.

In spite of distance and isolation, the National Broadcasting Company, over a nation-wide hook-up, will broadcast the progress of the expedition towards its destination, will describe the course of the preparations in the weeks ashore and on eclipse day will give very extended accounts of the observations as they are being carried out on June 8.

SCIENCE ON THE RADIO

FOR two hours and fifteen minutes each week, the nation-wide radio networks carry seven programs of science. In the form of dialogues, dramatizations and talks, these sustaining programs are the result of cooperation between two networks and the several scientific or educational organizations. The networks contribute the time and the producing organizations prepare the programs and arrange for their presentation. Each of the talks is carried by a chain of about 30 to 60 stations and each brings forth a considerable amount of listener interest.

In addition to these programs on the networks, there are numerous programs of local stations which are devoted more or less regularly to science. Sometimes other network programs, such as those devoted to agriculture, include scientific material. Many broadcasts are given at the time of scientific meetings and on other special occasions.

A weekly talk on "Science News of the Week" is prepared in continuity form by Science Service and sent to local broadcasting stations, many of them connected with educational institutions, for reading by an announcer. Since this talk is used by about 50 stations, it is in effect a broadcast available to the whole nation.

The world wide short wave station W1XAL at Boston performs another sort of service in acting as a sort of scientific journal of the air. Each day at 4:55 P. M. EST, cosmic data ursigrams and scientific news furnished by Science Service and often astronomical and other news are broadcast on 11.79 megacycles.

The science programs regularly on nation-wide networks are listed below. Times given are Eastern Standard. CBS means Columbia Broadcasting System and NBC means National Broadcasting Company. Local stations carrying these programs can be determined by reference to programs in local newspapers.

TUESDAY AFTERNOON:

3:45 to 4:00 P.M.—*Have You Heard?*—Curious and interesting facts in natural science, presented under the auspices of the Federal Office of Education. NBC Blue Network.

5:00 to 5:30 P.M.—*Your Health.*—Dramatized health broadcasts under auspices of the American Medical Association. NBC Blue Network.

5:15 to 5:30 P.M.—*Science Service Series.*—A leading scientist is interviewed each week by Watson Davis, director of Science Service. CBS Network.

6:00 to 6:15 P.M.—*Science in the News.*—Arranged by the University of Chicago Educational Council. NBC Red Network.

THURSDAY AFTERNOON:

2:00 to 2:15 P.M.—*Academy of Medicine.*—Medical programs, arranged by the New York Academy of Medicine. CBS Network.

SATURDAY AFTERNOON:

5:30 to 5:45 P.M.—*Drama of the Skies.*—Dr. Clyde Fisher, of the Hayden Planetarium, speaking on astronomical subjects. CBS Network.

SUNDAY MORNING:

11:30 to 12:00 A.M.—*The World is Yours.*—Dramatizations based on Smithsonian Institution activities, arranged by cooperation with the Federal Office of Education. NBC Red Network.

WATSON DAVIS

PRESENTATION OF THE WILLIAM H. NICHOLS MEDAL TO DR. WHITMORE

DEAN FRANK C. WHITMORE, of the School of Chemistry and Physics of Pennsylvania State College, president-elect of the American Chemical Society, received on February 26 the William H. Nichols Gold Medal of the New York Section of the society, at a dinner given jointly by the section and the Society of Chemical Industry at the Hotel Pennsylvania.

More than 400 scientific men, representing many different fields of knowledge and investigation, united in honoring Dean Whitmore, who was awarded the medal for studies in "metallo-organic compounds, especially those of mercury, and in the field of aliphatic chemistry, particularly in molecular rearrangements and in the polymerization of olefins."

Dr. Walter S. Landis, vice-president of the American Cyanamid Company and chairman of the Nichols Medal Jury of Award, presented the medal, which was established in 1902 by the late Dr. William H. Nichols, a leader of the chemical industry and a charter member of the American Chemical Society, to "stimulate original research in chemistry." To insure perpetuation of the medal, a gift of securities was made recently to the New York Section by C. W. Nichols, chairman of the board of the Nichols Engineering and Research Corporation and son of William H. Nichols. Members of

the 1937 Medal Jury, in addition to Dr. Landis, were Dr. L. W. Bass, Dr. J. M. Weiss, Professor A. W. Hixson and Professor Victor K. LaMer.

Dean Whitmore, in his address of acceptance, discussed recent research on polymerization and the genesis and interrelation of his chemical investigations. Professor Marston T. Bogert, of Columbia University, past president of the society, spoke on the scientific achievements of the medallist, and Dr. Gerald L. Wendt, director of the American Institute of the City of New York, outlined his personal career. In his address Dr. Whitmore reported that with the aid of a dozen assistants, he has succeeded, after five years of work, in removing most of the "magic and uncertainty" attached to reactions involved in polymerization, and in reducing these complex changes to an orderly basis.

Dr. Whitmore was born in North Attleboro, Mass., on October 1, 1887, and received his early education in Atlantic City, N. J. Later he attended Harvard University, taking the degree of bachelor of arts in 1911, of master of arts in 1912 and of doctor of philosophy in 1914. He was instructor in organic chemistry at Williams College in 1916–17 and at the Rice Institute in 1917–18. From 1918 to 1920 he was assistant professor at the University of Minnesota, when he joined the faculty of Northwestern University with the rank of professor, serving as head of the department of chemistry from 1924 to 1929, leaving to become dean at Pennsylvania State College.

He is consultant and member of the Scientific Advisory Committee of the Chemical Warfare Service, and was formerly chairman of the Division of Chemistry and Chemical Technology of the National Research Council. In 1932 he was vice-president of the American Association for the Advancement of Science and chairman of its chemical section. Beginning with the treasurership of the Southwest Texas Section in 1917, Dean Whitmore has held many offices in the American Chemical Society, of which he has been a director since 1927. He was an officer of the Division of Organic Chemistry for eight years, and is an associate editor of the *Journal* of the society.

SCIENTIFIC NOTES AND NEWS

THE John Scott Awards for 1937 of the City of Philadelphia, $1,000 and a copper medal, were presented on March 5 to Dr. W. D. Coolidge and Dr. Irving Langmuir, director and associate director of the research laboratories in Schenectady of the General Electric Company, and to Dr. Evarts A. Graham, professor of surgery at the Washington University Medical School, St. Louis. The award to Dr. Coolidge was for his application of a new principle in x-ray tubes and that to Dr. Langmuir for development of the electric bulb now in common use. The award to Dr. Graham was for his application of the x-ray to the study and diagnosis of gall bladder conditions. Dr. Ernest T. Trigg, chairman of the Board of City Trusts, made the presentations.

THE seventieth birthday of Dr. Adolf Meyer and the beginning of his twenty-fifth year as director of the Henry Phipps Psychiatric Clinic of the Johns Hopkins University Medical School will be celebrated on April 16 and 17.

HONORARY scrolls in recognition of "outstanding contributions to the human race" have been awarded by the Columbia Graduate School Alumni Association to John Kunkel Small, head curator of the New York Botanical Garden; Jesse Feiring Williams, of Teachers College; Victor Emanuel Levine, professor of biological chemistry at Creighton University, and William Crocker, director of the Boyce Thompson Institute for Plant Research, Yonkers.

A BANQUET was given on March 4 at Northwestern University for members of the faculty who had served for twenty-five years. These included Dr. Robert Blue, Dr. James Carr, Dr. Arthur Curtis, Dr. Alexander Day, Dr. Charles Freeman, Dr. William Holmes, Dr. George Meyer, Dr. Stephen Ranson and Dr. John A. Wolfer, *medicine;* Professor William Bryan and Professor Walter K. Smart, *English;* Professor William Burger and Professor Herbert Philbrick, *engineering;* Professor Elton J. Moulton, *mathematics;* Professor Horace Secrist, *economics;* Dr. William Skillen, *dentistry;* Professor David Himmelblau, *accounting.*

A TESTIMONIAL dinner to Willis H. Carrier was held on February 25 at the Boston Chamber of Commerce, with members of eight societies of air conditioning, heating, refrigerating, mechanical and metallurgical engineers attending. Mr. Carrier made an address on the application of air-conditioning work at the Robinson Deep Mine in the Rand Gold Fields of South Africa.

Museum News calls attention to the following awards made to scientific men in South Africa: K. H. Barnard, assistant director of the South African Museum, Capetown, has been awarded the senior Captain Scott medal by the South African Biological Society in recognition of his researches with South African crustacea and fish. H. M. L. Bolus, curator of the Bolus Herbarium, University of Capetown, has received an honorary degree of doctor of science from the University of Stellenbosch. John Hewitt, director of the Albany Museum, Grahamstown, received the South African medal and

grant from the South African Association for the Advancement of Science at its annual meeting in October at Johannesburg, in recognition of his contributions in zoology and South African prehistory.

THE British Institution of Chemical Engineers has awarded the Osborne Reynolds Medal to Lord Leverhulme, for contributions to the progress of chemical engineering, and the Moulton Medal to Professor D. M. Newitt, of the Imperial College of Science and Technology, for his work on the design of vessels to withstand high internal pressures.

DR. JOHN HENDLEY BARNHART, of the New York Botanical Garden, has been elected president of the Torrey Botanical Club for 1937. He has also become editor for the New York Academy of Sciences.

THE Association of American State Geologists has elected the following officers for the year beginning March 1. *President,* Arthur Bevan, state geologist of Virginia; *Vice-president,* Walter F. Pond, state geologist of Tennessee, and *Secretary,* Raymond C. Moore, state geologist of Kansas. These representatives of the association were also elected: To the National Research Council, Henry B. Kummel, state geologist of New Jersey, on the Division of States Relations, and Henry A. Buehler, state geologist of Missouri, on the Highway Research Board; to the Federal Board of Surveys and Maps, Edward B. Mathews, state geologist of Maryland; Washington, D. C., representative, George H. Ashley, state geologist of Pennsylvania.

DR. HANOR A. WEBB, chairman of the Division of Science and Mathematics of the George Peabody College for Teachers, was elected president of the National Association for Research in Science Teaching for 1937 at the meeting held in connection with the Department of Superintendence of the National Education Association at New Orleans. Dr. S. Ralph Powers, professor of natural sciences, Teachers College, Columbia University, was elected *vice-president;* Professor Ellsworth S. Obourn, head of sciences, John Burroughs School, *secretary;* Professor Fred Anibal, assistant professor of education, Stanford University, and Professor Walter G. Whitman, head of the department of science, State Teachers College, Salem, Mass., *members of the executive committee.* The association celebrated its tenth anniversary at this meeting.

HENRY BALFOUR, curator of the Pitt Rivers Museum, has been elected president of the Royal Geographic Society, London.

DR. SIMON FLEXNER, director-emeritus of the Rockefeller Institute for Medical Research, New York, was elected a trustee of the Johns Hopkins University on February 23.

DR. HUGO H. SCHAEFER, associate professor of chemistry at the Columbia University College of Pharmacy and director of its chemical laboratory, has been appointed dean of the Brooklyn College of Pharmacy of Long Island University. He succeeds Dr. William C. Anderson, whose retirement was recently announced.

DR. F. G. GREGORY has been appointed as from October 1 to the chair of plant physiology, University of London, tenable at the Imperial College—Royal College of Science. Since 1931 he has been assistant director of the research institute of plant physiology at the Imperial College.

PROFESSOR R. H. FOWLER, Plummer professor of applied mathematics in the University of Cambridge since 1932, has been elected a member of the Athenaeum Club for eminence in science.

MRS. AGNES CHASE, senior botanist in the Bureau of Plant Industry of the U. S. Department of Agriculture, has been appointed honorary custodian of the section of grasses in the U. S. National Museum. Mrs. Chase was associated with the late A. S. Hitchcock in building up the collection.

H. E. ANTHONY, of the American Museum of Natural History, has been made chairman of the Committee on the Preservation of Natural Conditions recently formed by the National Research Council.

DR. ADOLPH WEINZIRL, epidemiologist of the Baltimore Department of Health, has been appointed health officer of Portland, Ore. He will succeed Dr. John G. Abele, who will become city epidemiologist.

DR. NORMAN TAYLOR, formerly of the New York Botanical Garden and the Brooklyn Botanic Garden, has been appointed director of the recently established Cinchona Products Institute, New York City. The institute will promote medical and industrial research in the use and application of cinchona products.

DR. JOHN W. SCOTT, head of the department of zoology of the University of Wyoming, has been appointed executive secretary of the State Game and Fish Commission. Dr. Scott will be granted an indefinite leave of absence from the university and will assume his new work at once.

L. C. G. CLARKE, fellow of Trinity Hall, curator of the Museum of Archeology and Ethnology, has been appointed director of the Fitzwilliam Museum at the University of Cambridge and Marlay curator as from October 1, in succession to Sir Sydney Cockerell, who retires at the end of September.

DEAN CORNELIUS BETTEN, of Cornell University, sailed on February 24 for England. He plans to work in the British Museum and expects to be absent for three months.

DR. ALWIN M. PAPPENHEIMER, professor of pathol-

ogy of the College of Physicians and Surgeons, Columbia University, and Dr. Frederic M. Hanes, of the School of Medicine of Duke University, have made a stay of several weeks at the School of Tropical Medicine at San Juan, Puerto Rico.

DR. HERMENEGILDO ARRUGA, director of the clinic of ophthalmology at Barcelona, Spain, who has been an exile from his native land since early in the Spanish civil war, is making a lecture tour through the United States, South America and Europe. He plans to return to Spain after the war.

DR. WALTHER KUBIENA, of the Agricultural Institute, Vienna, will be guest professor of soils at the Iowa State College from April 1 to September 30.

DR. THORVALD MADSEN, director of the State Serum Institute of Denmark, who will deliver the Abraham Flexner Lectures at the School of Medicine of Vanderbilt University, will be in residence during the months of March and April. The dates and titles of the individual lectures are: March 10, "Control of Venereal Diseases in Denmark"; March 15, "Mechanism of Bacterial Infection"; March 19, "Epidemiology of Tuberculosis"; March 24, "The Influence of Seasons on Infections," and March 29, "Whooping Cough."

OWING to the flood emergency, it was necessary for Surgeon General Thomas Parran to postpone the Gehrmann Lectures scheduled at the College of Medicine of the University of Illinois, from January 25, 26 and 27 to March 22, 23 and 24. The subjects of the lectures are: "Health as a Factor in Social Security"; "Industrial Hygiene" and "Syphilis."

DR. I. S. BOWEN, professor of physics in the California Institute of Technology, gave on February 17 an illustrated lecture on "Bright-Line Astronomical Spectra" before the University of California at Los Angeles Chapter of the Society of the Sigma Xi.

DR. HERBERT S. GASSER, director of the Rockefeller Institute for Medical Research, will deliver the sixth Harvey Society lecture of the current series at the New York Academy of Medicine on March 18. Dr. Gasser will speak on "The Control of Excitation in the Nervous System."

THE Royal College of Surgeons, England, has appointed Sir Charles Gordon-Watson Bradshaw lecturer for 1937 and Sir Charles Sherrington Thomas, Vicary lecturer.

THE seventh annual meeting of the American Association of Physical Anthropologists will be held on April 9 and 10 at the Faculty Club of Harvard University.

THE date at which the spring meeting of the Midwestern Psychological Association will be held has been changed from April 23 and 24 to May 7 and 8.

THE thirty-second annual meeting of the Southern Society for Philosophy and Psychology will be held at Columbia, S. C., on Friday and Saturday, March 26 and 27, 1937, under the presidency of Lyle H. Lanier. The University of South Carolina is the host institution. Separate sections for contributed papers in philosophy and psychology have been arranged for the Friday morning and afternoon sessions; the Saturday morning meeting will be devoted to papers of general interest from both fields. The annual banquet and presidential address are scheduled for Friday evening at the Hotel Columbia. The annual business meeting will follow the Saturday morning session.

FORMATION of a Cancer Council, to bring together the fields of cancer education, therapy and research and to serve as a liaison agent between the outstanding authorities in cancer and the lay public through the medium of the press and radio, has been announced by Dr. Clarence C. Little, managing director of the American Society for the Control of Cancer. Members of the council include Dr. Frank Adair, of Memorial Hospital, appointed by the regents of the American College of Surgeons; Dr. Karl Kornblum, appointed by the president of the American Roentgen Ray Society; Dr. Little and Dr. James B. Murphy, of the Rockefeller Institute for Medical Research, appointed by the council of the American Society for Cancer Research; Dr. James Ewing, of Memorial Hospital, and Dr. Burton T. Simpson, State Institute for the Study of Malignant Diseases, Buffalo, appointed by the directors of the American Society for the Control of Cancer. The first meeting of the council was held on March 5.

DR. WILLIAM J. ROBBINS, dean of the Graduate School at the University of Missouri, and president of the Missouri Academy of Science, has appointed a standing Committee of the Academy on Conservation, with the following membership: H. C. Beckman, U. S. Geological Survey, Rolla; Dr. H. A. Buehler, state geologist and director, Missouri Bureau of Geology and Mines, Rolla; Dr. H. H. Krusekopf, professor of soils, University of Missouri; Dr. G. T. Moore, director, Missouri Botanical Garden, St. Louis; A. E. Shirling, professor of science, Kansas City Teachers College; E. Sidney Stephens, president, Restoration and Conservation Federation of Missouri, Columbia; Dr. R. H. Westveld, assistant professor of forestry, University of Missouri, and Dr. Rudolf Bennitt (chairman), associate professor of zoology, University of Missouri. The purposes of the committee are: (1) to keep the membership of the academy informed of current activities in the many fields related to conservation of natural resources; (2) to direct the influence of the academy in support of conservational moves which are for the public good, and (3) to assist in placing the scientific resources of this state-wide organization at

the disposal of agencies working toward conservation of the natural resources of Missouri.

A SUIT for recovery of $215,730, allegedly lost by the American Society of Mechanical Engineers in publishing *The Engineering Index,* was brought up in Supreme Court when the plaintiffs moved on February 16 for appointment of a temporary receiver for The Engineering Index, Inc., a separate corporation which has published the index since 1934. The plaintiffs are two members of the society, Clifford J. Stoddard and John Parker, suing on behalf of themselves and other members. The complaint alleges that in 1927 the society advanced money for the *Index* and for a service known as the Engineering Card Index Service, but that eventually the Engineering Index, Inc., was organized as a non-profit-making corporation to publish the magazine, the society receiving a small percentage of the income. The suit seeks to invalidate this agreement and wants an accounting of the corporation. A similar suit, brought in 1935, was dismissed after an official referee found that "no property or funds of the American Society of Mechanical Engineers has been misappropriated or diverted to any other purpose than for which the society was incorporated."

THE *Manchester Guardian* prints in its issue of February 7 the following: "The *Berliner Tageblatt* reports a lecture given by Geheimrat (Privy Councillor) Professor Dr. Stark, president of the National Physical and Technical Institution (Physikalisch-Technische Reichsanstalt), on 'Dogmatism and Experience in Atomic Research.' Professor Dr. Stark, according to this report, rejected the theory of the form of the atom the moment it was put forward by Lord Rutherford and Niels Bohr—less on technical (sachlichen) grounds than from fundamental objections to their acceptance of views and dogmas of Jewish physicists. He now wished not only to criticize but to bring forward something better as an alternative. He described his new model of the atom with the aid of a short film. Its main feature is that the electron has not the form of a sphere, assigned to it by the Jewish physicist Abraham, but that of a vortex-ring (Wirbelring). Jewish influence, said Professor Dr. Stark, had gone so far that even non-Jewish scientists like Planck, Bohr, Von Laue, Schrödinger and Heisenberg had become partisans of the false doctrine (Irrlehre), and no young lecturer who gave a thought to his career dared to oppose the dominant theory. Some particularly pushing physicists married Jewish women in order to advance their careers. Now that these monstrous circumstances had been discovered, German and authentic (arteigene) physics would forge ahead. 'Privy Councillor Stark's lecture is to serve,' the report concludes, 'as a new thrust to eliminate from German physics the effects of the Jewish mind.' Unfortunately, Stark said in conclusion, in the two decades no important discovery had been made by physicists of the German alignment."

DISCUSSION

SURVIVAL OF MARMOTS AFTER NEPHRECTOMY AND ADRENALECTOMY[1]

IN studying a series of nephrectomized marmots (*Arctomys monax*) during the early part of 1936, it appeared very strange that the first animals used did not seem to suffer any ill effects from the operation. Both kidneys had been completely removed at one sitting. For two, three and (in some cases) four weeks they ate and drank freely and appeared in good health, fighting vigorously with their cage-mates occasionally like normal animals. This is strikingly different from observations made on other mammals: rats, guinea-pigs, cats and dogs quickly show severe effects and survive only a few days after bilateral renal excision. All the marmots which were nephrectomized eventually succumbed, however, with the usual symptoms observed in other animal forms. In many observed cases, food was eaten within a few hours of death.

Recalling earlier observations on adrenalectomized marmots which survive for months—until spring time—when operated on during the winter, it was thought possible that seasonal variations in survival after nephrectomy might also be shown by this species. Several animals were nephrectomized, therefore, throughout the summer period—or the warmer half of the year, from April to September, in this latitude. In all these cases the post-operative life-span was very short and approximated that found in the usual laboratory types.

In the winter-nephrectomized group (October to March), four marmots survived 28 to 35 days and two others 21 days each; the average survival period in seven cases was 20 days. In 15 summer-operated animals the life-span averaged, in contrast, only 6 days. The latter group showed considerable reductions in serum sodium and chloride, and more marked rises in blood urea than the winter-operated series. Very high blood urea values, running sometimes over one per cent., were observed.

[1] Grateful acknowledgment is made of aid received from the Rockefeller Foundation.

Observations on adrenalectomized marmots are in me respects similar to the above. Prolonged sur-vals (average 70 days in 12 cases) occur when the renal glands are removed in the months from Octo-r to March, and very short survivals (average 5 days 19 cases) are observed in summer.[2] All animals hich are adrenalectomized in winter survive until pring, however, when they die with the usual symp-ms of insufficiency. Early winter-operated individ-als thus show much longer survival times than others. ive marmots adrenalectomized in November and ecember, for example, showed survivals which aver-ged 98 days, while 5 operated on in February and arch averaged only 44 days. No comparable winter-onth variations in survival have been observed after ephrectomy. There is apparently a definite survival mit of about 4 weeks for winter-nephrectomized mar-ots, while that for adrenalectomized animals may ry from 5 to 20 weeks according to the time of peration.

It is emphasized that the marmot does not hibernate nder ordinary laboratory conditions which are kept irly constant throughout the year. Body tempera-re, feeding habits and general activity are normally aintained in winter as in summer, and the body eight is frequently increased. Winter-nephrec-mized (or adrenalectomized) marmots are indistin-ishable from normal unoperated animals until within few hours of death. The remarkably long survivals corded above are probably not referable, therefore, any reduction in metabolic activities. The dispen-bility of renal and adrenal functions for very pro-nged periods in the marmot is well demonstrated.

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THE BLACK WIDOW SPIDER IN VIRGINIA

RECENTLY, several articles on the distribution of the lack widow spider, *Latrodectus mactans*, have ap-eared in SCIENCE. In Lowrie's contribution[1] the tatement is made that there now are " . . . only eight tates (Minnesota, Iowa, Virginia, Delaware, New Jer-y, Connecticut, Rhode Island, Vermont) in which he spider has not been officially recorded." If by officially recorded," publication in a scientific periodi-l is meant, this statement is at variance with one in article by D'Amour, Becker and Van Riper,[2] who ombine the distribution records of Burt[3] and Bogen[4] and remark that this " . . . leaves only the following states from which the black widow has not been reported: Oregon, Minnesota, Iowa, Missouri, Wisconsin, Illinois and Vermont." If Oregon, Wisconsin and Illinois, states in which *Latrodectus* has been reported recently,[5] are subtracted from this second list, then only Minnesota, Iowa, Missouri and Vermont are left. When comparison is made with Lowrie's list, they agree on just three states, in which the spider is unreported officially, *viz.*, Minnesota, Iowa and Vermont. By implication, the Lowrie list places the black widow in Missouri while, similarly, the D'Amour article places it in Virginia, Delaware, New Jersey, Connecticut and Rhode Island.

With respect to Virginia, it was rather surprising to find it said that there was no official record from this state, since the black widow is common to abundant in most of the state. There have been several articles on the effect of its bite in the *Virginia Medical Monthly* and the *Proceedings* of the Virginia Academy of Science for 1934–1935 lists a paper on *Latrodectus* read by Elizabeth Burger, then a graduate student in the Department of Biology, College of William and Mary. The synopsis of this paper includes "the incidence of arachnidism in Virginia." In her unpublished master's thesis, on file in the William and Mary library, Miss Burger tabulates 118 cases of Virginians who suffered the serious bite of this spider, the result being fatal in one instance, that of a two-year-old boy in Charlottesville. These data, gathered from a questionnaire sent to hospitals and physicians throughout the state, can not be considered as complete, and also occasional errors in diagnosis are possible, so that the real incidence might be somewhat higher. We are privileged to quote as follows:

> The majority of these cases were in Tidewater Virginia especially around Norfolk and Richmond, and on the Eastern Shore. Fifteen cases from Bristol show that the range of the black widow extends into the mountains in this state.
>
> A large proportion of these cases occurred since 1930. Most of the cases happened in the spring, summer or fall, during the natural breeding season of the spider. . . . The spiders were located in privies in 25 instances, in a garden four times, in bed in three cases, on the ground in three instances, and once each in a stump, baseball glove, bathing suit, tobacco sticks and on a porch. Most of the patients had seen the spider, which they described as "black like a shoe-button with a red spot."

In the vicinity of Williamsburg, specimens can be secured at any time merely by investigating such sites as under stones or bits of wood, along brick walls or

[2] S. W. Britton, *Amer. Jour. Physiol.*, 99: 9, 1931.
[1] Donald C. Lowrie, SCIENCE, 84: 2185, 437, November 3, 1936.
[2] F. E. D'Amour, F. E. Becker and W. Van Riper, *Quart. Rev. Biol.*, 11: 2, 123, June, 1936.
[3] C. E. Burt, *Jour. Kans. Ent. Soc.*, 8: 4, 117, 1935 (cited by Lowrie).
[4] Emil Bogen, *Ann. Internal Medicine*, 6: 375, 1932.
[5] H. M. Field, SCIENCE, 83: 2147, 186, February 21, 1936, and L. H. Townsend, SCIENCE, 84: 2183, 392, October 30, 1936 (both cited by Lowrie).

foundations at the ground level and on or under vegetation where the air is damp. One spring day, Miss Burger and the writer took 50 individuals of varying stages from the stones of a rock-banded curbing 35 × 2 feet in area. Six months later, the identical site yielded five mature females, one mature male and two immature females. A pile of scattered fenceposts left lying in a field in April had from one to six mature females under each post in October.

In the fall of 1935, an undergraduate in one of the writer's classes was bitten on the hand upon retrieving a tennis ball. Apparently in the very short interval of time the ball lay in the grass outside of the court, a female black widow clung to it and then inflicted the bite as it was picked up. This student's symptoms were typical: The sensation of a pin prick, pain increasing in intensity and localizing in the lower torso, a marked rigidity of the abdominal muscles and prostration. In spite of opiates and other measures, pain, so intense that a wooden gag was necessary, was experienced for about two days. Apparently this case is the first time a student has been bitten while in residence, though the spiders are seen on nearly every collecting trip. In the Elementary Biology Laboratory, one or more *Latrodectus* cultures are kept going most of the year and all students in field courses are warned to respect this dangerous arachnid.

From his personal experience, the writer has concluded that (1) the black widow is abundant in Tidewater Virginia, (2) it is unlikely to inflict its poisonous bite unless handled, and far from invariably then, and (3) its bite is so serious, especially to children, that reasonable caution should be observed when poking into situations where it is likely to be.

It may be relevant to conclude this account with a true and rather amusing anecdote. Some Williamsburg children, sons and daughters of professors as well as colored children, are in the habit of collecting insects and spiders and selling them to biology students for one cent each. One little colored boy discovered purveying black widows at this price was told of the dangerous character of such merchandise. A few days later he was found still selling black widows—but his price had jumped to a nickel each.

RAYMOND L. TAYLOR

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COLLEGE OF WILLIAM AND MARY

THE ADSORPTION-ABSORPTION AND TRANSLOCATION OF DERRIS CONSTITUENTS IN BEAN PLANTS

OBSERVATIONS in field work in which derris and cube were used as insecticides showed possibility of the constituents of these roots being adsorbed-absorbed and translocated to new growth of the treated plants.

Two varieties of beans (Pinto and Burpee Stringless Green-pod), grown in pots under greenhouse conditions, were treated before the first trifoliate leaves appeared with suspensions of derris in water, containing 0.025, 0.05 and 0.25 per cent. rotenone. Some of the plants were treated by spraying the entire plant with a compressed-air hand sprayer, some by painting only the first pair of true leaves and some by painting only the stems.

As soon after treatment as the first trifoliate leaves had attained a fair size or about the time the second trifoliate leaves were opening, the first trifoliate leaves were removed from the plants and used for tests. Larvae of the Mexican bean beetle (*Epilachna varivestis* Muls.), confined in open glass cells, were allowed to feed on these leaves and the leaf areas consumed were measured. There was very low mortality among the larvae feeding on the new growth from either the treated or the untreated plants. There was, however, a definite reduction in feeding area of new growth on treated plants over that on untreated plants. This reduction in feeding area was observed on the first, second and third trifoliate leaves.

Chloroform extracts were prepared from the same plants as those used for the feeding tests. These extracts were prepared for biological and chemical tests by evaporating to dryness and removing the residue with acetone. An aliquot of the acetone solutions was tested against goldfish (*Carassius auratus*) in water suspension, and 100 per cent. mortality was observed in every case. No mortality was observed in extracts prepared from untreated plants. Where sufficient leaf material was available, an aliquot was used for the colorimetric analysis.

The data accumulated thus far indicate that derris constituents are being adsorbed-absorbed and translocated to new growth of bean plants treated with a suspension of derris powder in water.

A more detailed paper will be presented elsewhere.

ROBERT A. FULTON
HORATIO C. MASON

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, U. S. DEPARTMENT OF AGRICULTURE

THE SIXTH EDITION OF THE BIOGRAPHICAL DIRECTORY OF AMERICAN MEN OF SCIENCE

A NEW edition of "American Men of Science" is now in preparation. It should be ready in about a year, the present plan being to issue the work once in five years. The fifth edition was published in March, 1933; the dates of publication of the earlier editions were 1906, 1910, 1921 and 1927, one edition having been omitted owing to war conditions. The number

tries in each successive edition has been about 4,000, 500, 9,500, 13,500 and 22,000.

This geometrical increase in the number of Amer-an workers in science is most promising for the ture of our civilization; but it makes difficult the eparation of a biographical directory containing all e names. Those listed in the directory have prob-ly done more for the welfare of the American people an all the business men of New York and all the olitical leaders in Washington. But by the nature of ings only a few of them can be distinguished.

For a long series of years I compiled and printed in CIENCE a list of all doctorates in science given by merican universities with the subjects of the theses. 1906 when the first edition of "American Men of cience" was published there were 139; now there e nearly 2,000. The increase in college graduates still greater; in high-school graduates it is truly markable.

It is a problem of interest, which a work such as American Men of Science" may help to solve, whether cientific men as a group are now on the average less le or do less important work than formerly. They e less distinguished; there may be as many leaders a savage tribe as in a great nation. The saying e can not see the forest for the trees" may be re-ersed to "we can not see the trees for the forest." e should expect to find more able men in a group of 000 than in a group of 139, but it may be that the lection is now less severe. We certainly seem not to ve as many great men of science as in 1906.

For the new edition of "American Men of Science" e have on cards more than 12,000 new names sup-osed to have the qualifications used in previous ditions. These are the possession of a doctor's degree r similar preparation, the publication of research ork contributing to the advancement of science, and e holding of a position that promises a scientific areer. It is difficult to select from those having these ualifications the ones who may be expected to con-ribute most to the advancement of science; yet it is ow or will soon become impossible to include in one olume biographical sketches of all those in America ho are engaged in scientific work. Under these con-itions the editors would like to receive advice from hose included in the directory concerning the ad-isability of several alternatives, namely: (1) Publish he book in two volumes; (2) decrease the length of he entries; (3) give only the names, addresses and ositions of those whose sketches have not been hanged significantly since the preceding edition was ublished and (4) limit the entries to about 25,000 of hose whose work is supposed to be of most value.

In spite of the circumstance that the directory is s large as it should be, it is the object of this com-munication to ask those who read it to send to the editors the names, addresses and qualifications of scientific men and women whose names do not appear in the fifth edition and who should now be included. Our lists are nearly complete for those who have received higher degrees since the last edition was published, for those who hold positions in some seven hundred colleges and universities, for those who have contributed to leading scientific journals and for members of scientific societies with research qualifications. But there are other groups not so complete, such as physicians, engineers and others engaged in the professions who have contributed to the advancement of science; teachers in normal colleges, junior colleges and high schools; federal, state and municipal employees; workers in industrial and private laboratories, amateurs and others.

It is further urged that those who have not returned the requests for the needed information do so at once and that those who have received the entries from the fifth edition return them as soon as is convenient with the needed corrections and additions. Proofs will be sent when the sketches have been put in type. It is most desirable that entries and proofs be returned promptly, for otherwise the sketches can not be included in the book, except in special cases when the data can be verified from other sources.

The omission of names that should be included not only detracts from the value of the book, but may be serious for those concerned, for the directory is largely used in connection with appointments, awards, the acceptance for publication of manuscripts and the like. A university executive told me recently that he used the book more frequently than any other and had supplied an additional copy to each of his two secretaries. An executive responsible for recommending the award of large sums in grants has told me that when he leaves home he always takes a copy with him.

The Biographical Directory of American Men of Science is not intended to be only an address book, though it is hoped that as such it is useful. The editor was originally interested in collecting the material for a scientific study of scientific men. Perhaps no advance in our knowledge of the material world can be of such great value as knowledge concerning the natural qualities and environmental conditions favorable to scientific research. If we find the men and give them the opportunity the rest will follow. A second primary object of the work is to make men of science acquainted with one another and with one another's work. As the editor remarked in the preface to the first edition:

> There scarcely exists among scientific men the recognition of common interest and the spirit of cooperation which would help to give science the place it should have in the community. It is fully as important for the nation

as for men of science that scientific work should be adequately recognized and supported. We are consequently in the fortunate position of knowing that whatever we do to promote our own interests is at the same time a service to the community and to the world.

The editorial work and difficulties in the preparation of the book are great; the costs of preparation and publication are large. The editors ask those engaged in scientific work to continue the cooperation that they have given in connection with the earlier editions over a period of thirty-five years.

J. MCKEEN CATTELL

GRAND CENTRAL TERMINAL,
NEW YORK, N. Y.

SCIENTIFIC BOOKS

GEORG WILHELM STELLER

Georg Wilhelm Steller, the Pioneer of Alaskan Natural History. By LEONHARD STEJNEGER, Cambridge, Mass. Harvard University Press, 1936. Pages i to xxiv, and 1 to 623. Frontispiece in color of Catesby's and Steller's Blue Jays; headpiece, the Free Imperial City of Windsheim; and plates 1 to 29. Price, $6.00.

THE cross marking Steller's grave and the grave itself have long since washed away; but the young and enthusiastic German naturalist, for twelve years in the employ of the Imperial Academy of Sciences of Russia, has a much greater monument in the biography just published by Stejneger. There is no one so competent to write such a book. As he says in his introduction, the subject of this biography was thrust upon him and was not picked out by choice. Its inception dates back to the days when Professor Spencer F. Baird, secretary of the Smithsonian Institution and director of the National Museum, commissioned the author to go to Bering Island to investigate rumors about the Steller sea-cow, which the hero had discovered on Bering's ill-fated expedition to Alaska. At that time Stejneger spent two summers and one winter (1882–1883) on the Komandorski Islands and Kamtchatka, the winter being passed on Bering Island where the remnants of Bering's crew, including Steller, wintered in 1741–42. Since then Stejneger has visited Bering Island four times, but for much shorter stays. It is no wonder that he became interested in the life of Steller.

Stejneger was more fortunate than Steller; for, though he never saw a live sea-cow, he brought back skeletons, while Steller, for lack of room on the rebuilt *St. Peter*, was permitted no space for carrying to Kamtchatka such a large animal.

During his visit Stejneger made a detailed map of the island, every part of which had been traversed by Steller or the other survivors. This map was used as the topographical basis for the work of the Russian Geological Survey.

There is practically nothing in Steller's life that Stejneger has omitted. Beginning with his family history, his birth on March 10, 1709, Plate 1 is a photostatic copy of the page of the St. Kilian Church register, Windsheim, showing the record of Georg Wilhelm Stöhler's baptism. When Stöhler entered the Russian service, he found no satisfactory equivalent of the letters of his name and so changed it to Steller. In 1927 the author visited Steller's birthplace, and in 1930 went to Halle to look into his university background. He also searched libraries and obtained many photostatic prints of manuscript records regarding Steller's life. Steller had a gifted mind. He was a theologian, physician and, most of all, a naturalist. He was a true "medical truant." Only three times in the book does the reviewer recall references to Steller as a physician: first when he early entered the Russian Army service, later and foremost during the outbreak of scurvy aboard Bering's vessel, the *St. Peter*, on the second Kamtchatka Expedition, and finally when he was critically ill and refused to take medical advice, saying that he was a medical man capable of looking after others and also himself. The outbreak of scurvy is excellently described. It is interesting that two naval surgeons of the second ill-fated Kamtchatka Expedition, both Germans, Johan Theodor Lau and Heinrich Schäfer, attended Steller in his last illness (1746) at Tyumen, Siberia, although they had not been assigned to the *St. Peter*.

One is struck with the absence of a portrait of Steller, until on page 157 he reads: "Unfortunately no description of Steller's physical attributes has been handed down to us, much less any portrait." His mental characteristics are better known, namely, that he was high-strung, temperamental and indefatigable. His industry and innate optimism are well brought out, for, when shipwrecked on an unknown island (Bering), he wrote the manuscript of "De Bestiis Marinis" when other men would have bemoaned their fate.

Forty-four pages at the end are designated as appendices:

A. A description of the pictures of the sea-cow. [Exterminated in 1854, if not earlier.]
B. Steller as an ichthyologist.
C. Steller as a botanist.
D. Steller's hitherto unpublished letter [to Johann Georg

Gmelin] dated Jan. 14, 1740. [A report of his activities.]

Steller's Catalogus Plantarum intra sex horas in parti Americae septentrionalis juxta promontorium Eliae observatarum anno 1741 die Iulii sub gradu latitudinis 59. This is the first list of Alaskan plants, about 150, and shows what an indefatigable collector Steller was.

The frontispiece is a copy of Catesby's blue jay, *Cyanocitta cristata,* of the eastern United States as contrasted with the western blue jay, *Cyanocitta stelleri.* It was the presence of this blue jay that made Steller sure North America had been reached; and this is an illustration of the remarkable memory Steller had, as he had once seen a copy of Catesby's work in St. Petersburg many years previously, before he started on his extensive travels.

Stejneger's narrative of the voyage of the *St. Peter* under Commander Vitus Bering[1] from Kamtchatka to Kayak Island, Alaska, until it was shipwrecked at Bering Island, then the making of the new but smaller *St. Peter* and its voyage to Kamtchatka is as interesting reading as Conrad.

The book is more than a biography of Steller, because it gives an account of the history, customs and manners of Russia in Steller's time, two hundred years ago, also much about the lives of his associates. It is well illustrated, but one regrets that it does not contain more plates. The author has left no stone unturned in acquiring facts about Steller's life, either by travel or by correspondence. It is concluded with a bibliography of two hundred and fifty-one titles, many of them in the Russian language. Steller's share in it is seventeen titles written in German and Latin, all the seventeen, except one, published posthumously. The index is complete both as to subject-matter and scientific names. The volume is a model of book-making, well bound and printed on an excellent grade of paper.

M. W. LYON, JR.

RAFINESQUE

Rafinesque's Kentucky Friends. By HARRY B. WEISS. Privately printed. Highland Park, New Jersey, 1936. 70 pp., 25 portraits. For sale by the author (price $7.50), Highland Park, New Brunswick, N. J.

DAVID STARR JORDAN thus characterizes the subject of this little book, "Brilliant, erudite, irresponsible, fantastic, he wrote . . . of the fishes of the Ohio River with wide knowledge, keen taxonomic insight, and a hopeless disregard of the elementary principles of accuracy. Always eager for novelties, restless and credulous, his writings have been among the most difficult to interpret of any in ichthyology."

Constantine Samuel Rafinesque (1783–1840) was born at Constantinople, the son of a French father and of a German mother born in Greece. His early boyhood was spent mainly in Italian seaport cities. In 1802 he came to Philadelphia, but returned to Italy in 1805. The next 10 years seem to have been spent in scientific work in Sicily, but in 1815 he came to America again. In Philadelphia he met Mr. John D. Clifford, of Lexington, Kentucky, and was invited by him to visit his home in Lexington. In May, 1818, Rafinesque started, making the trip by stage, boat and on foot. Clifford persuaded Rafinesque to come to live with him in Lexington and promised to procure for him a professorship in natural history in Transylvania University. Rafinesque returned to Philadelphia, shipped his books and collections to Lexington, and himself returned there in the summer of 1819.

Dr. Weiss devotes 14 pages of his book to Rafinesque's life in Kentucky: to his teaching in the university, to his scientific trips and collections and to his scientific writings and publications while there, and particularly to his relations with the people among whom he lived. Because of his exaggerated temperament, he was a very difficult person to live and work with, especially after he developed a persecution complex. But all this is set out in Dr. Weiss's sketch and need not be gone into further.

Rafinesque was a talented artist, as is vouched for by the 25 sketches which are reproduced in the book. He seems to have been in the habit of sketching his friends or acquaintances at any time and place. Among these sketches are drawings of his mother, sister, and either of his wife or her sister. The others are chiefly of men and women prominent in the political and social life of Lexington and of Kentucky. The unidentified portraits are mainly of girls and young women, possibly children of his friends.

One is disappointed not to find any record of the whereabouts of the original sketches. These sketches have little value to the man interested in Rafinesque's scientific work. But as documents in the history of Lexington and of Kentucky of the time covered by Rafinesque's life in Lexington they are of undoubted value.

E. W. GUDGER

IN HONOR OF PROFESSOR HONDA

Professor K. Honda Anniversary Volume. October, 1936. Sendai, Japan.

THIS volume of more than 1,100 pages is published in the series of Science Reports of the Tôhoku Imperial University, Sendai, Japan, as a tribute to Professor Kôtarô Honda, now president of the university,

[1] One member of the Danish family Bering, using the name Bierring, served in the American Navy during the Civil War, and his son was president of the American Medical Association recently.

on the completion of twenty-five years of his professorship. The Science Reports are so well known to scientists working along many varied lines that nothing need be said to emphasize and enlarge upon their value and worth. The present volume is an outstanding one. It signalizes not only the personal efforts and accomplishments of Professor Honda, but also the great contributions of his pupils in the university and in the world-renowned Research Institute for Iron, Steel and Other Metals.

Of the 97 papers, 24 are contributions from American and European workers. A wide range of subjects is discussed, including metallurgy, magnetism, mechanical properties of materials, chemistry, spectroscopy, x-rays, mechanics, mathematics, meteorology and instrument design. However, 54 of the papers deal with metallurgy and magnetism, reflecting Professor Honda's influence in these fields. Many of the papers, especially those by American and European contributors, are in the nature of theses summarizing work which has extended over a long period. For this reason, they should prove especially valuable for reference.

The volume contains a bibliography of the 167 scientific papers and 8 books written by Professor Honda and a brief biography. Unlike our own custom in similar volumes, no photograph is included.

LYMAN J. BRIGGS

SPECIAL ARTICLES

A RECENTLY ISOLATED STRAIN OF POLIOMYELITIC VIRUS

IN the winter of 1934 an outbreak of poliomyelitis with a high mortality rate occurred in Sacramento, California. Fresh cord from a fatal case was obtained through the courtesy of Dr. Paul Guttman, of the Sutter Hospital, and proved to contain poliomyelitic virus upon inoculation of a monkey. The animal became completely paralyzed and was sacrificed in 6 days after injection of 2 cc of the 10 per cent. suspension intracerebrally and 8 cc intraperitoneally. The virus could be transmitted in series to other monkeys, and since then has been carried successfully through eight generations. Because of the fulminating and severe course of the outbreak, largely among high-school students in Sacramento, it was thought of interest to make a comparison of this virus with the monkey passage strain originally received from the New York City Health Department, and with several others on hand, especially one (Jackson) that had previously been recovered during the summer of 1934 from a fatal case in San Francisco.

The disease in the monkey after intracerebral inoculation was clinically similar to that usually noticed with the monkey passage strain, increased temperature, excitability, tremor, staccato voice, followed by flaccid paralysis of the extremities and complete prostration within 6 to 11 days after injection. The incubation period was usually 6 to 7 days, similar to that of the more active passage strain, but in making comparison it should be recorded that 10 per cent. instead of 5 per cent. cord was generally used as the basic suspension. The former upon titration has proven viable in a 1–200 to 1–400 dilution. The passage strain on the other hand could be titrated to a dilution of 1–3200 from a 5 per cent. suspension, so that the more recently isolated strain lacked the higher infectiousness shown by the older adapted one. The Jackson also lacked this more active virulence, although on one occasion it was potent in a 1–800 dilution.

Recently Trask and Paul[1] have reported a slight variation in a strain of poliomyelitic virus isolated from a case in southern California during the same year, 1934. Their strain showed an affinity for the peripheral nerves with greater and more constant regularity than with the other strains tested. In like manner this new Sacramento virus also seemed to have this property, since it was found unexpectedly that very small quantities of filtered suspension could produce the disease with typical paralysis when given intradermally. In attempting to immunize 2 monkeys one was given 0.5 and 1 cc of filtered virus (Berkefeld N filtrate), respectively, one week apart, and the other 0.2 and 0.6 cc, respectively, at a 9-day interval. Both animals developed poliomyelitis within a week after the second inoculation. At the same occasion five other animals were immunized to the active passage strain by the same route, being given larger doses (1 to 5 cc) of unfiltered material over a 5-week period without any casualties.

Cross neutralization tests were performed to determine any possible serological differences with the other strains. From previous experiments made at various times, no difference in cross immunity had ever been noticed between the monkey passage strain and several recently isolated human strains (N. Y. and Fly) kindly sent by the Rockefeller Institute and by Dr. J. R. Paul, of Yale University, respectively. Any differences were those of lower virulence or of inability to produce the disease unless with large doses.

Serum was obtained from 2 monkeys, Nos. 1334 and 1499. The former (1334) was immunized to the Sacramento strain of virus and the latter had recov-

[1] J. D. Trask and J. R. Paul, *Jour. Bacteriol.*, 31: 527–530, 1936.

from an attack of the disease and was then erimmunized with the same strain. Three separate s with serum of No. 1334 and two with serum No. 1499 taken at different periods during immuni- on all failed to protect against the standard amount 25) of monkey passage virus, while on the other d the serum of each animal neutralized its homol- us virus. Neutralization tests were also made, g the Sacramento strain diluted either 1–10 or 5 against serums of animals immunized to the kson and to the passage strains of virus, respec- ly. Neutralization occurred in 4 of the 5 trials, uding one using hyperimmune horse serum of high ency.[2]

Tests for cross tissue immunity were then made in ich 3 animals were used that had recovered from ttack of the disease after receiving the Sacramento in and 2 that had been immunized to this same ns. All 5 monkeys were given intracerebral injec- ns of the passage virus, three receiving a 1–50 dilu- n and 2 the undiluted 5 per cent. suspension. Two mals withstood the inoculations and 3 became para- ed. The former were both animals which had overed from the first attack of the disease, while y one of the group was among the less resistant ies.

Three monkeys immunized to the monkey passage ain over a long period of time and resistant to intra- ebral inoculation of their homologous viruses were o given similar inoculations of the Sacramento ain. Two of these remained well, although one veloped a high temperature, accompanied by ner- sness and excitability, while the third became erely paralyzed in both legs, with partial arm alysis. The test doses in each case were usually ge, 2 cc intracerebrally and 10 or 15 cc intraperi- eally of a 10 per cent. suspension.

Neutralization tests with serums from 3 monkeys munized against the Jackson strain showed protec- n against the passage virus when used in a 1–25 ution, while 2 animals (Nos. 1354 and 1371) immune the Jackson strain were also immune after intra- ebral inoculation of the more potent heterologous us, in a 1–25 dilution. All control animals suc- mbed to this same dose. In all respects except high tency the Jackson strain seemed immunologically ilar to the passage virus.

On the other hand, there is apparent difficulty in e interpretation of the results with the Sacramento ain. While there is a certain degree of cross pro- tion, it is mainly manifest in one direction. Pro- tion was noted when serums were used from nkeys immunized to the passage virus or, with one ception, when animals had been immunized to this strain. While the serum of this latter animal protected against its homologous strain of virus and it was also immune against intracerebral inoculation, yet neither its serum neutralized the Sacramento strain nor was the animal itself resistant against a massive dose of the latter virus.

In contradistinction, tests with the Sacramento serums never protected against the passage virus, and 60 per cent. of the immune Sacramento monkeys lacked tissue immunity against this same strain.

From the evidence presented and from accumulating reports of others, it appears that not all strains of poliomyelitic virus are quantitatively or even qualitatively similar. References are either to a quantitative difference, as shown by the lower invasive power of the more recently isolated strains when compared with the far more virulent monkey passage virus, as recently reported by Kessel and his associates[3] or to comparisons of the differences in neutralizing ability of immune serums against recently isolated or passage strains.[4,5,6,7] Burnet and Macnamara,[8] however, recorded a qualitative difference between their Australian poliomyelitic virus and that of the MV strain of the Rockefeller Institute, as have Paul and Trask[9] in this country for two human strains recovered in the eastern United States. The former reported that two monkeys recovered from an attack of poliomyelitis induced by the Australian virus were not immune to the MV strain, while one animal partially paralyzed by the latter succumbed to a later inoculation of the local virus. These results are very similar to those presented here for the new California strain. Somewhat similar properties are shown, except that the latter strain also offers the affinity for the peripheral nerve trunks not so readily shown by the others, except for the one recently reported by Trask and Paul.[10] Since their virus was also recovered in California during the same year, although from a widely separated locality, one might expect a closer relationship. Erber and Pettit[11] in France have alluded to a possible lack of identity among 4 separate recently isolated strains. Their results were not sufficiently definite, however, to draw any real distinctions in differentiation.

[2] B. F. Howitt, SCIENCE, 80: 621–622, 1934.

[3] J. F. Kessel, R. VanWort, R. T. Fisk, and F. D. Stimpert, *Proc. Soc. Exp. Biol. and Med.*, 35: 326, 1936.

[4] E. R. Weyer, *Proc. Soc. Exp. Biol. and Med.*, 29: 289, 1931.

[5] S. Flexner, *Jour. Am. Med. Asn.*, 29: 1244, 1932.

[6] B. F. Howitt, *Jour. Infect. Dis.*, 53: 145, 1933.

[7] J. R. Paul and J. D. Trask, *Jour. Exp. Med.*, 61: 447–464, 1935.

[8] F. M. Burnet and J. Macnamara, *Brit. Jour. Exp. Path.*, 12: 57–61, 1933.

[9] J. R. Paul and J. D. Trask, *Jour. Exp. Med.*, 58: 513–529, 1933.

[10] *Loc. cit.*

[11] B. Erber and A. Pettit, *Compt. rend. Soc. de biol.*, Paris, 117: 1175–1178, 1934.

Inasmuch as decided immunological differences have been distinguished between separate strains of other viruses such as those of equine encephalomyelitis[12] and of human encephalitis[13,14] wherein the same clinical manifestations are given by the respective strains within each group of viruses, it may well be worth considering such a possibility for the virus of poliomyelitis. Regional differences in strains, not only in respect to invasive power or potency but in respect to qualitative dissimilarity of the antigenic structure, might help to account for the mildness of an outbreak in a certain section as compared to the severity in another. While undoubtedly the high immunity rate of the community as a whole, regardless of how accomplished, largely accounts for the comparatively low morbidity in poliomyelitis, yet sudden outbreaks with an unexpectedly high mortality rate do occur and might well be ascribed to a virus of slightly different immunological makeup combined with high infectiousness. In judging the results of serum therapy, therefore, account should be taken of possible differences in virulence of the virus in different regions combined with a possible difference in antigenic structure. A population ordinarily exposed to a milder strain of virus might not be resistant to one of greater potency and consequently would not respond as well to treatment with serum from those immune to the former strain.

In conclusion, a recently isolated strain of poliomyelitis virus has been found to possess certain immunological properties combined with a slight difference in tissue reactions that suggest the possibility of finding both a qualitative as well as a quantitative difference in the strains of virus causing poliomyelitis.[15]

B. F. HOWITT

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RELATION OF CERTAIN VIRUSES TO THE ACTIVE AGENT OF THE ROUS CHICKEN SARCOMA[1]

THE belief held by some investigators that mammalian tumors are caused by viruses is due largely to the demonstration by Rous[2] that the tumor-produc agents of some chicken sarcomas do not lose t activity when passed through a Berkefeld filter. T evidence in support of this hypothesis has been forth in detail recently by Andrewes[3] and Rous,[4] a will not be discussed here. Instead, we wish to re some observations distinguishing the active agent the Rous chicken sarcoma No. 1 from two well-rec nized virus diseases: vaccinia, an animal infecti and tobacco mosaic, a disease of plants.

The lipid fraction of the Rous chicken sarcoma capable of reproducing the tumor in a high percent of inoculated animals.[5] Allard[6] tested the effect various lipid solvents on the dried virus of toba mosaic. Very few of them affected its activity, a the lipid extracts were always inactive. We have b unable to find reports of similar experiments with t virus of vaccinia, though many attempts to use th solvents as disinfecting agents have been made.[7]

The work of Stanley,[8] with the virus of toba mosaic disease, and of Northrup,[9] with bacteriopha indicates that the infective agents in these diseases a protein in nature, and therefore we should not exp to recover them in the lipid extracts by the techniq we are using. The experiments to be described w conducted with two possibilities in mind. It is c ceivable that the active agent of the tobacco mos disease might be merely adsorbed by the protein cr tals, though this would seem improbable in view Stanley's repeated recrystallization of the protei In addition, they will serve as a check on the wo done in this department with the Rous chicken sa coma, as it is possible that a protein, representing t active principle, has been carried along in the lip extract. The solvents used would seem to obviate th possibility, and chemical and biological tests ha failed to reveal its presence.

The material used in the vaccine virus experime consisted of three lots:[10] first, calf skin pulp, fro promptly and kept in this condition until the time the experiments; second, calf pulp dried immediat

This investigation has been aided by a grant from t Josiah Macy, Jr., Foundation.

[2] Peyton Rous, *Jour. Exp. Med.*, 13: 397, 1911.

[3] C. H. Andrewes, *Lancet*, 2: 64 and 117, 1934.

[4] Peyton Rous, *Jour. Cancer Res.*, 28: 233, 1936.

[5] James W. Jobling and E. E. Sproul, SCIENCE, 84: 2 1936.

[6] H. A. Allard, *Jour. Agric. Res.*, 6: 649, 1916.

[7] W. Palmer Dearing, *Am. Jour. Hygiene*, 20: 4 1934.

[8] William M. Stanley, *Phytopathology*, 26: 305, 1936.

[9] John D. Northrup, SCIENCE, 84: 90, 1936.

[10] We wish to express our appreciation to Dr. Clow of Mulford and Company, to Dr. Reichel, of Sharpe a Dohme, and to Dr. Beard, of Lederle and Company, f the large amounts of vaccine virus which we found nec sary in these experiments.

[11] Aided by grants from the anonymous Poliomyelitis Donation of the Hooper Foundation and from the President's Birthday Ball Commission for Infantile Paralysis Research.

[1] From the Department of Pathology, College of Physicians and Surgeons, Columbia University, New York City.

[12] B. F. Howitt, *Jour. Immunol.*, 29: 319–341, 1935.

[13] L. T. Webster and G. L. Fite, *Jour. Exp. Med.*, 61: 411–422, 1935.

[14] R. Kawamura, M. Kodama, T. Ito, T. Yasaki and R. Kobayakawa, *Arch. Pathol.*, 22: 510–523.

he Lyophile apparatus; and third, chick embryo s, which was frozen while fresh and dried *in vacuo*. no instance had preservatives been added. The zen material was thawed and ground to a fine pulp passage through a meat grinder. It was then ed in tubes, frozen with carbon dioxide snow and icated in the Flosdorf-Mudd Lyophile apparatus. the first experiment carbon tetrachloride was used solvent; in the second, petroleum ether; and in third, the solvent consisted of equal parts of petro- ether and chloroform, as experience with chicken coma has shown this mixture to be a better extrac- . However, with the technique described, all three vents have extracted the active principle from the coma. In each instance the dried, finely ground terial was put in a flask and extracted 3½ hours four changes of the solvent in a water bath kept 37° C. During extraction nitrogen was bubbled ough the mixture with the double purpose of keep- it agitated and driving out the air. The solvent filtered until clear and evaporated to dryness in tream of nitrogen at 37° C. under negative pres- . The dried lipid extract was divided into three tions, one of which was emulsified in distilled ter; the second, in a 10 per cent. saline extract of bit skin, as this was to be the test animal; and the d, in a 0.5 per cent. casein solution. The casein tion was added because it has proved capable of serving or augmenting the activity of the lipid m the Rous sarcoma, which was inactive when in- ted alone, and the skin extract because of the fre- ncy with which lesions occur in this tissue. Each paration was tested on the skin and cornea of bits.

To test the activity of the original material, some the dried but unextracted tissue was suspended in ter at 37° C. for two hours. It was then centri- ed and the supernatant fluid tested on the cornea skin of rabbits. After removal of the solvent, an ract of the treated pulp was prepared in a similar nner to learn if the virus had been destroyed by the vent.

Briefly, the extract of the untreated virus was found be quite active on both the cornea and the skin of bits, while the lipid extracts failed to produce any ion. The water extract prepared from the lipid racted residue was also active. Guarnieri bodies re present in the corneas of the rabbits inoculated h extracts of the untreated dried virus, and of the racted tissue residue, but not in those inoculated h the lipid preparations. Identical results were ained in three experiments.

The air-dried tobacco mosaic virus No. 1[11] and the nts inoculated in our tests, the *Nicotiana glutinosa L.*, were obtained from the Boyce Thompson Institute through the kindness of Dr. Helen Beale.[12] The local-lesion method[13] was used in inoculating the plants. In these experiments, the technique of preparing the extracts was similar to that used with vaccine virus and Rous chicken sarcoma. In the first experiment the solvent used was carbon tetrachloride and in the second, petroleum ether. In both experiments the disease was produced with water extracts of the unextracted and the extracted dried leaves, but there was no evidence of it in the plants inoculated with the lipid extracts.

If we accept the rather generally held view that a disease-producing agent which retains its activity after being passed through a Berkefeld filter should be termed a virus, then we must believe that viruses should be classified according to their chemical properties—as proteins, lipids, etc.—and in the lipid group place the Rous chicken sarcoma. However, it would seem more logical to look upon the agent causing chicken sarcoma not as a virus but as a product of abnormal cell metabolism. It is most unlikely that the lipid can reproduce itself, and therefore it seems probable that it possesses the ability when injected into normal animals under proper conditions to stimulate normal cells to produce a similar substance and thus perpetuate the disease. Certainly our failure to produce disease with the lipid extracts of the two viruses examined indicates that they are of a different chemical nature.

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INFLUENCE OF DEUTERIUM OXIDE ON PHOTOCHEMICAL AND DARK REACTIONS OF PHOTOSYNTHESIS

IN experiments previously reported,[1] cells of the alga *Chlorella* liberated O_2 about 0.41 as rapidly in buffers prepared with 99.9 per cent. D_2O (deuterium oxide or heavy water) as in those prepared with H_2O (0.02 per cent. D_2O); CO_2 was supplied in excess and illumination intensity was 6,500 lux (correction from 2,000). To study the influence of D_2O on different stages of the photosynthetic process, additional experiments have been made with the manometric technique previously described. Warburg's[2] No. 9 buffer, prepared with potassium salts, was used in the light intensity experiments, and 0.1 M $KHCO_3$ alone was used in the experiments with intermittent light.

[11] James Johnson, *Wisconsin Agric. Exp. Sta. Res. ll.*, 76, 1927.

[12] We wish to express our great appreciation to Dr. Helen Beale, not only for supplying us with material, but also for teaching us the technique used in this type of experiment. Without her assistance the work would have been much more difficult.

[13] Francis O. Holmes, *Bot. Gaz.*, 87: 39, 1929.

[1] J. Curry and S. F. Trelease, SCIENCE, 82: 18, 1935.

[2] O. Warburg, *Biochem. Zeit.*, 100: 230–270, 1919.

Preparations were exposed to continuous light for 15 minutes before observations were begun, and all rates were corrected for respiration by means of tests in darkness. Light for the first series of experiments was furnished by a bank of Mazda lamps placed under the manometer vessels. Intensity of illumination was measured at the bottoms of the vessels by means of a Macbeth illuminometer. Different intensities were obtained by varying the wattage of the lamps and the distance between them and the vessels.

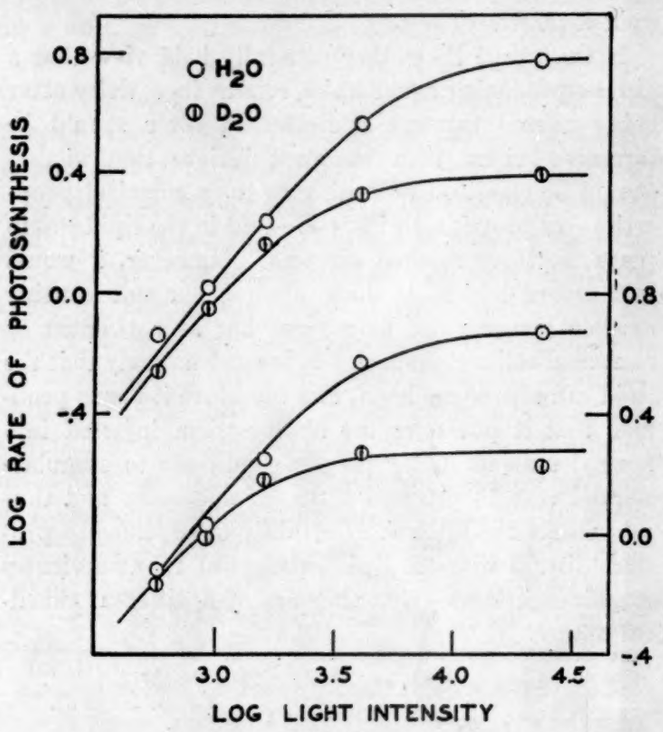

FIG. 1

Data from two typical experiments[3] are plotted in Fig. 1. (The temperature for the upper pair of curves was 23.0° C.; for the lower, 24.9° C.) The smoothed curves were drawn according to the critical equation proposed by Smith,[4] $KI = p/(p^2_{max.} - p^2)^{1/2}$, in which p is the rate of photosynthesis at light intensity I, K is a constant that locates the curve on the I axis, and $p_{max.}$ is the asymptotic maximum rate of photosynthesis.

It may be seen that with high light intensity, when the velocity of the dark chemical reaction determined the rate of the total reaction, D_2O strongly depressed the rate of photosynthesis. But with low light intensity, when the speed of the photochemical reaction determined the rate of the whole process, D_2O exerted but relatively little influence. These results indicate that D_2O retarded the rate of the dark reaction of photosynthesis, but had little, if any, effect on the photochemical stage of the process.

[3] F. N. Craig and S. F. Trelease, *Amer. Jour. Bot.*, 24: in press, 1937.

[4] E. L. Smith, *Proc. Nat. Acad. Sci.*, 22: 504–511, 1936.

Subsequent experiments with intermittent illumination furnished additional direct evidence for this conclusion. Light intensity of 41,400 lux at the bottoms of the manometer vessels was obtained by means of a system comprising a 500-watt projection lamp, a set of lenses and a mirror. For obtaining intermittent illumination, a solid disk with a suitable opening was rotated vertically in front of the light source at r.p.m., so that the cells were exposed to 15 flashes of light per second—each flash being followed by a relatively long dark period. Light was available to per cent. or more of the cells in each vessel about per cent. of the time. The duration of a single flash was about 4.5×10^{-3} seconds, and the length of dark interval was about 62.2×10^{-3} seconds. The temperature was 23.9° C.

Representative results from one of these experiments are plotted in Fig. 2, which shows evolution

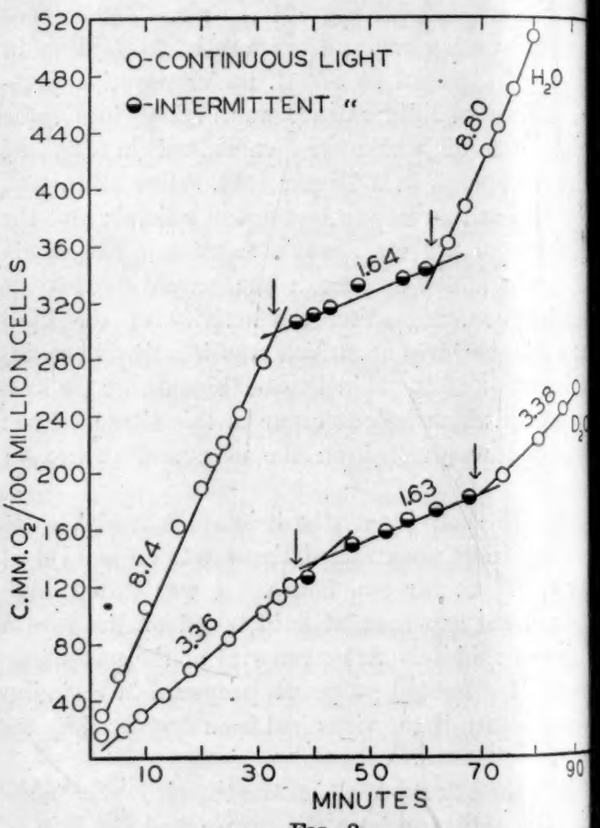

FIG. 2

O_2 from 100 million cells as a function of total ti The number near each curve gives the slope or r of photosynthesis. Since the portions of the cur representing O_2 evolution in intermittent light essentially parallel, it is evident that when the d period after each light exposure was long enough allow the dark reaction to proceed to completion D_2O, the rate of photosynthesis was as great in D as in H_2O. Apparently the dark reaction proceed as far in D_2O as in H_2O, although its velocity w lower in the former. Additional experiments of t

me type have shown that these results are reproicible. It therefore appears that the principal inence of D_2O on photosynthesis is to retard the dark action, and that D_2O affects the photochemical stage the process very little, if at all.

Through the use of the rotating disk the amount of ght received by the cells per minute was reduced pproximately 93 per cent., but in neither D_2O nor $_2O$ was photosynthesis reduced commensurately with e amount of illumination. Computations based on e data plotted in Fig. 2 show that per unit amount light supplied, the amount of photosynthesis was creased in intermittent illumination approximately 75 and 615 per cent. in H_2O and D_2O, respectively. ince the methods employed to obtain intermittent lumination differed somewhat from those of other investigators,[5] the values given here can not be compared with the data published by these writers for photosynthesis in H_2O.

Perhaps the most important implication of our experimental results is that H_2O as well as D_2O enters into the dark stage rather than into the photochemical stage of photosynthesis.

We hope to present elsewhere a detailed account of these and other experiments in which the D_2O concentration, CO_2 concentration, temperature and ratio of dark interval to light interval were varied.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD OF MEASURING ROTATIONAL SPEEDS

THE development of the ultracentrifuge has made t necessary to measure rotational speeds over wide anges. In some of our previous experiments the peed was varied from about a hundred to over wenty thousand revolutions per second. Usually the orking speeds are between 500 r.p.s. and 3,000 .p.s.[1] Several different methods of measuring speeds f rotation in this range may, of course, be used, but n practice they are comparatively complicated and equire special or expensive equipment. Also, as in he case of some forms of the stroboscopic method, are must be taken by the observer to distinguish etween the fundamental and its harmonics.

A method is described in this paper which is practically free from the above objections and is almost ideally suited to the measurement of rotational speeds over much wider ranges than necessary at present. Fig. 1 shows a schematic diagram of the apparatus.

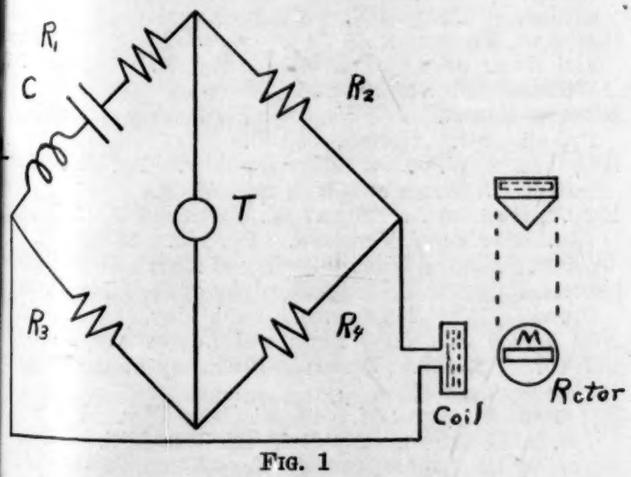

FIG. 1

A small magnet M fastened to the high speed rotor or driving turbine induces an alternating current in the coil, which is connected across a bridge that can be balanced at only one frequency. An inspection of the circuit shows that the bridge will balance when

$$\frac{R_1}{R_2}=\frac{R_3}{R_4} \text{ and } Lw=\frac{1}{Cw} \text{ or } N=\frac{1}{2\pi\sqrt{LC}}$$

where R_1, R_2, R_3 and R_4 are non-inductive resistances; L inductance, C capacity and N the frequency of the alternating current in the bridge. Therefore, the procedure in measuring the rotational speed of the rotor is simply to vary either C or L until T indicates that the bridge is balanced. Then from the known value of L and C the number of revolutions per second N is computed. The indicating instrument T may be a loud speaker, telephone receiver, thermocouple galvanometer, etc., used either with or without an amplifier, depending upon the sizes of the rotating magnet and coil as well as their distance apart. In our experiments the magnet was either a piece of sewing needle (1 to 2 cm in length) or a small cobalt steel magnet. These small magnets when properly mounted do not disturb the balance of the high-speed rotors or turbines. The resistances $R_2=R_4=300$ ohms, and $R_3=100$ ohms. They were ordinary non-inductive wire-wound resistances. $R_1=100$ ohms and included the resistance of the inductance L. Three fixed mica condensers were used in various combinations as the capacity C, while L was a variable inductance (5 to 25 millihenries). The capacity could thus be varied in large steps, while L could be varied continuously. Table I shows values for the rotational speed com-

[1] Beams and Pickels, *Rev. Sci. Instruments*, 6: 299, 1935.

[5] R. Emerson and W. Arnold, *Jour. Gen. Physiol.*, 15: 391–420, 1932; 16: 191–205, 1932. Warburg, *loc. cit.*

TABLE I

N Bridge	N Stroboscope
551 r.p.s	545 r.p.s.
627	612
870	858
1108	1090
1244	1250
1355	1333
1417	1412
1548	1540
1745	1738
1915	1936
2156	2182

puted from settings on the bridge and from simultaneous stroboscopic determinations made with a rotating slotted disk. It will be observed that they are in good agreement. As a matter of fact, the values obtained stroboscopically were much less precise than those obtained with the bridge. The settings on the bridge were so "sharp" that the precision was limited only by the precision with which the scale on the inductance could be read. With fixed capacities, the scale on the inductance can be calibrated directly in revolutions per second.

The above method therefore possesses the following advantages: (1) The apparatus is inexpensive, simple to operate and easily obtainable or constructed. (2) The rotational speed is read directly, and no special skill is required of the observer, since only one frequency will balance the bridge. (3) Its calibration does not change. That is, the settings are independent of the strength of M and the position of the coil. (4) The readings can be made about as accurately and quickly as desired, and this makes it possible to follow rapid fluctuations in the speed of the rotor. (5) The balance of the bridge also may be used indirectly to control the rotational speed when this is desirable.

It is indeed a pleasure to acknowledge a grant from the Rockefeller Foundation for the development of the ultracentrifuge.

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INSTRUMENT TENTS

SEVERAL visitors at this laboratory have regarded with interest a simple arrangement which is in use here for protecting a large spectrophotometer from the accumulation of dust or exposure to spilled material or humid atmosphere. At the risk of duplicating any current information, one visitor's suggestion that a brief note be published on the matter has been adopted.

Ordinary cloth sheets, towels or black cloths, placed over colorimeters, microscopes, spectroscopes or other optical instruments afford little more than superficial protection against moisture, and defeat another purpose by actually leaving deposits of dust and lint upon exposed optical surfaces. Yet when an instrument is in frequent use, or must remain for some hours in an undisturbed position, or is without a wooden case (all three of which contingencies apply to this spectrophotometer) it is desirable to protect it from dust and moisture. To meet such needs, we have had a large tent of specified shape and dimensions constructed out of yellow oiled silk, such as is used in wet surgical dressings, shower-curtains, etc.; some Cellophane derivative might serve as well.

Tents of such material in any specified shape or size can be constructed readily, usually by local companies. The material is transparent enough that the instrument may be seen when covered, tough, pliable, washable, lasting, light enough to be removed and replaced readily without risking accidental disturbances to adjustment of verniers, settings, mirrors, etc., and affords gratifying protection against dust and moisture.

For the covering of large instruments, use may be made of the simple contrivance employed here: a narrow strip of canvas, sewn along the midline at the top of the spectrophotometer-tent, supports a series of small metal rings, by which the whole tent is suspended by strings to a light dowel extending the length of the tent. The dowel is in turn suspended from the ceiling by a pair of small cords running over pulleys. Thus when the instrument is to be used, the light tent is easily drawn up and hung out of the worker's way. When desired, it can be readily relowered over the instrument. It is important that the tent cover the instrument completely, its bottom edges meeting the table surface.

DENIS L. FOX

SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIF.

BOOKS RECEIVED

AKELEY, MARY L. J. *Restless Jungle.* Pp. xiii + 313. Illustrated. McBride. $3.00.

BELL, E. T. *Men of Mathematics.* Pp. xxi + 592. 30 plates. Simon and Schuster. $5.00.

HAMILTON, LEICESTER F. and STEPHEN G. SIMPSON, Editors. *Talbot's Quantitative Chemical Analysis.* Eighth edition. Pp. xiv + 297. 12 figures. Macmillan. $2.50.

HOFFMAN, FREDERICK L. *Cancer and Diet; With Facts and Observations on Related Subjects.* Pp. xx + 767. Williams and Wilkins. $5.00.

HORNEY, KAREN. *The Neurotic Personality of Our Time.* Pp. xii + 299. Norton. $3.00.

HUMPHREYS, W. J. *Weather Rambles.* Pp. 265. Illustrated. Williams and Wilkins. $2.50.

KELLY, HOWARD A., AUDREY W. DAVIS and H. C. ROBERTSON. *Snakes of Maryland.* Pp. 102. 33 figures. 10 plates. Natural History Society of Maryland, Baltimore.

LOOMIS, FREDERIC B. *Physiography of the United States.* Pp. viii + 350. 212 figures. Doubleday, Doran. $2.75.

New Jersey Pharmacy Laws and Regulations, June 30, 1936. Pp. 122. Board of Pharmacy of the State of New Jersey. $1.00.

PRENTISS, AUGUSTIN M. *Chemicals in War.* Pp. xviii + 739. 139 figures. 2 plates. McGraw-Hill. $7.50.

Report of the Department of Scientific and Industrial Research for the Year 1935–36. Cmd. 5350. Pp. 195. His Majesty's Stationery Office, London.